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A PLAN OF MANAGEMENT OF CRANIAL INJURIES BASED ON A NEW GROUPING OF SUCH INJURIES

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MUCH confusion has arisen concerning the term concussion, contusion, and compression of the brain. When, as is so often the case, these conditions are complicated by other conditions such as intracranial hemorrhage, there is still greater difficulty. It is frequently difficult, therefore, to draw a clear mental picture of the underlying pathology of these conditions and hence to decide which cases fall under these various clinical headings. It follows that without a "clear-cut" understanding of the pathology and, therefore, of these clinical conditions themselves, it is impossible to lay down adequate regulations for treatment. It was the idea of attempting to clarify this atmosphere in our own minds that led us to discard the terms of concussion, contusion and compression for practical use. The grouping of brain injuries which we suggest in their place has at least the advantage of simplicity, a much needed factor in any attempt to substitute one classification for another in regard to these injuries. In fact, classifications of disease or traumatic conditions in general have no value, unless on the basis of such a classification a rational treatment can be built. This essential we believe is met in the grouping we propose.

In dealing with intracranial lesions, acute or chronic, caused by disease or trauma, a most important factor to take into consideration is *intracranial pressure or tension.* In most of the chronic lesions, as brain tumors, intracranial tension is given the importance due, but such is not the case in acute brain injuries. It is our belief that acute intracranial tension is just as important as chronic intracranial tension. Much has been written of acute brain injury and we do not propose to quote from this extensive literature. But while acute intracranial tension is often referred to, notably by Jackson and Sharpe, it seems that to few is it the one condition which means life or death to the patient. It has come to be our belief that this is so irrespective of whether we label these cases concussion, contusion or compression. Fortunately, intracranial tension can be estimated by clinical as well as by a more exact means, namely, the spinal manometer. Furthermore, each of these groups have definite indications for treatment based entirely on the presence

or absence of increased intracranial tension. On this basis we now classify all cases of brain injury as follows:

Group 1. No increase in intracranial tension.

Group 2. Moderate increase in intracranial tension.

Group 3. Marked increase in intracranial tension.

In order to determine which of these groups the patient falls into, the following observations can now be made, after the stage of surgical shock has been passed:

A. General examination including neurological findings.

B. Observation of the temperature, pulse, respiration and blood-pressure every four hours.

C. X-ray of skull.

D. Spinal puncture, being careful to estimate pressure by means of the spinal manometer. As a result of examination the following types of cases will readily fall into one of these groups. Some will, of course, pass in progressive stages from one group to another.

Into Group 1 (no increase in intracranial tension) those cases will fall showing a normal spinal pressure of 8 to 10 mm. of Hg. and a normal or slightly elevated blood-pressure. To these essential findings may be added the less important ones of a normal or slightly elevated temperature, pulse and respiration, primary unconsciousness, either momentary, or at most, lasting for several minutes, followed by headache and dizziness. Normal eye grounds. The treatment of this group is, of course, non-operative and consists of

A. Rest in bed (four to five days).

B. Ice-cap to head.

C. Sedatives as needed.

These cases of Group 1 always recover unless some serious complication arises.

Into Group 2 (moderate increase in intracranial tension) those cases will fall showing a spinal pressure from 10 to 18 mm. of Hg. moderate rise in blood-pressure, moderate rise of temperature and pulse-rate, and a normal respiratory rate. These cases may show the primary unconsciousness, followed by dazing and headache mentioned above. To these mental symptoms may be added mild confusion or delirium after the period of unconsciousness has passed. The eye-grounds will show a congestion of the retinal veins. The indications for treatment in this group are again non-operative and will consist of

A. Rest in bed.

B. Ice-cap to head.

C. Elevation of head of bed.

D. Therapeutic spinal puncture (10 to 25 c.c. of spinal fluid may be removed as often as necessary usually every twenty-four hours for several days or as much as is needed to reduce the reading of the spinal manometer to 8 to 10 mm. of Hg).

E. Intravenous injection of hypertonic saline (60 to 80 c.c. of a 15 per cent. solution) or magnesium sulphate by rectum as advocated by Fay.[4] Because of the ease with which magnesium sulphate may be given, this is perhaps more practical than the intravenous injections of hypertonic saline, although the latter solution is quicker in its effect and in the majority of the cases of this group it is only necessary to give one injection.

The majority of the cases of this group will get well unless some serious complication arises.

We believe that approximately 70 per cent. of all cases with brain injury will fall into one or the other of these two groups.

Into Group 3 (marked increase in intracranial tension) will fall those cases showing a spinal pressure above 18 mm. of Hg. an increased blood-pressure which will fall as this stage progresses. (Pulse-pressure is much more valuable than systolic or diastolic readings; when the pulse-pressure equals the pulse-rate, a good, single indication for operative relief of tension exists). These cases will show a normal or slightly elevated temperature until the final stage (medullary œdema) when hyperpyrexia is present. The pulse-rate will gradually become slower as well as full and bounding until it becomes subnormal as pressure advances. In the closing stage the pulse will again become rapid and weak. There will be stupor increasing to coma. The eye-grounds will show congestion of the retinal veins, and uncommonly, paling of the optic disk. (We believe that true choked disk does not occur in an acutely increased intracranial tension but optic atrophy may develop later.)

This group we believe calls for operative relief of tension, in addition to the measures outlined in the preceding two groups. It is our practice to perform a subtemporal decompression on the right side with drainage and at times a bilateral subtemporal decompression.

Since making use of this plan of management of cranial injuries, twenty cases have come under our observation. This small number is much too few from which to draw accurate deductions, and yet we feel justified in making a preliminary report of this plan at the present time because of the tremendous help we have derived from it in treating these cases and particularly in making the difficult decision for or against operative relief of tension. That acute intracranial tension cannot be relieved to any appreciable extent by means of a subtemporal decompression we have often heard. We feel sure that such tension can be relieved if the operation be done sufficiently early and yet, after conservative methods have had a reasonable trial. There has been ample clinical proof of this fact in the work as it has progressed thus far.

By following this plan, it has been comforting to know by accurate findings that increased intracranial tension has been maintained, in spite of conservative methods to reduce such tension and that, therefore, operative relief must be resorted to. There are many problems, of course, that have arisen during the observation of these first twenty cases on this plan. We hope to report on some of these problems in later reports on this subject, at which time we

expect to report statistics involving a series of cases so grouped and treated, sufficiently large to warrant drawing conclusions. The value of this plan lies chiefly in determining and treating accordingly those cases of intracranial injury falling into Groups Nos. 2 and 3. We do not, of course, perform lumbar puncture on the obviously mild case as the general symptoms will make it unnecessary to do so. Fortunately, as we have already stated, increased intracranial tension has other symptoms as the pulse-rate, pulse-pressure, mental condition, etc., none of which are complete, however, until to them a spinal pressure reading is added.

We have purposely omitted from this discussion such frequent complications of brain injuries as scalp wounds, fractures of the skull, intracranial hemorrhage, penetration of foreign bodies and localizing pressure on the brain from any cause, believing that these complications are operative indications in themselves and that the operative management of these complications has now been well standardized in general.

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ARTHROPLASTY UPON THE TEMPOROMANDIBULAR JOINT*

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It is stated that a proportion of cases of ankylosis recur after operation. Why? We have classified the causes of these recurrences in three groups.

1. Operations performed upon cases that are still in the active stage of arthritis. 2. Incomplete operations. 3. Cases where either inadequate or no forms of excisors were used.

These groups cover the entire field and are self-explanatory. The main cause of recurrence seems to be the lack of appreciation of the pathological changes produced in the muscles and fascia outside of the joints.

The pathological cause of ankylosis of course varies in the different cases. It has been well described elsewhere and has very little bearing on the prevention of recurrence. It will be admitted in this discussion that no cases should be operated upon until months after all active arthritis have subsided. In all cases that have had bony ankylosis for any length of time (my cases varied from six to twelve years) a muscular atrophy is produced from disuse with an invasion of fibrous tissue in the muscle; the fascia layers are foreshortened or have not stretched as they would have in the growth of the normal individual. From the muscular atrophy, the contractility of the muscle is impaired so that normal opening and closing could not be obtained if the joints were normal. To explain it more fully, we would compare it to a fractured arm which had been kept in the cast for ten weeks. One notes in the arm, it is impossible to move the fingers when the cast is removed, and it takes several weeks or months of training to redevelop the muscles of the arm, and if this is true of the arm, it is equally true of the muscles of the jaw, only in ankylosis of the jaw, it is frequently locked for years.

In cases just operated upon, we find the recovery of motion and the freedom of action is greatly increased by the use of some form of exercisor to redevelop the muscles and stretch the fibrous tissues.

In the first group of cause of recurrence, that is patients operated upon where there is still progressive arthritis present, an exercisor is the only means of retaining motion. We have increased the motion in the one case that came under our notice ten weeks after operation. In group 2 where incomplete operations have been performed, if an exercisor is used, the distance gained and freedom of motion is increased. As used on our newly operated cases, no difficulty was encountered.

* Read before the Philadelphia Academy of Surgery, December 3, 1923.

The study of selecting the best variety of exercisor has led us to use dental appliances, but they were discarded as impractical. Even the best required constant attention and are only applicable for each case. An exercisor which was applicable to all cases was finally developed. It has given entire satisfaction. The exercisor is composed of two flat plates, which are connected on either side by a spring which extends out approximately six inches. These springs are in turn connected one to another by a rod to prevent play. To strengthen these springs, two extra springs are placed on either side.

The method of use of this exercisor is to place the plates in apposition, then introduce the plates between the upper and lower jaw with the springs controlled by the hands of the patient on either side and gradually relaxing the grasp of the hand. The jaw will then be forced open. Now, have the patient attempt to close the jaws, thereby exercising the muscles of mastication and when he releases these muscles after an attempt to close, there is a sudden give which adds a little to the opening each time it is used. The mechanical action each time causes the atrophied muscles to redevelop. These exercisors should be used every two hours, the amount of force being first controlled by the hands on the springs. It is interesting to see the muscles redevelop and the patient enabled to open the mouth wider and wider. This is not all the exercisor does. It apparently causes the jaw to develop and take on the adult contour, for in cases where the jaw is locked in childhood, if seen in youth, there is a separation of the front teeth of one to one and a half centimetres. With its use, we have seen cases with contraction and limited motion develop so that a second operation was not necessary, as they had sufficient motion for chewing and speaking. We feel with this exercisor we can now practically state that no recurrence will occur with a correctly selected and performed arthroplasty. This exercisor is the result of the best and simplest of a considerable number of appliances which we have had made. It has the following advantages: It is of simple construction and can be controlled by the patient. It can be used interruptedly. The strength of the spring can be graded. So as to make it unnecessary for others to repeat our experiments, we would state we have tried clothes pins, wooden wedges, etc., and have discarded them as poor makeshifts. Permanently applied appliances to the teeth have to be applied by a dentist. They are difficult to obtain and inconvenient to the patient. They cannot be removed and are unsanitary as a rule. We have used a great many of the different varieties, but are entirely satisfied with the present model of exercisor. It has been well tested out. It may be added that in fibrinous contraction of various varieties, it has been of value to us. We would warn that no exercisor of any type should be used on any teeth in front of the canine, as frequently the teeth protrude forward and special pressure does not press upon the tips but only on the inner surface, thereby loosening the teeth and only too frequently a pericementitis develops and finally death of the teeth results.

The variety of the incision may be straight up and down in front of

the ear. One with the added triangular incision at right angles, to this over the zygoma or the question mark incision of Blair may be used. The next point—injury to the facial nerve. If it is a bony ankylosis, we agree that the nerve supply to the occipital frontalis is frequently impaired and this is caused not so much by cutting as by stretching the nerve to obtain sufficient room to remove the necessary amount of bone. Next—amount of bone to be removed. It is much better to remove too much of the condyle than not to remove sufficient, and we have seen cases in which too little bone has been removed. We had one case in which we found it necessary to divide the coronoid process before dilatation could take place. The next point in technic which we want to clear up is the question of whether the introduction of fat, either free or pedicled or muscle, is necessary. We are agreed that none of them are essential to obtain a good joint. They do no harm and may be used, but with the use of the exercisor after the removal of the bone, recurrence does not take place. We do feel there is less danger of infection, if the fat and muscle are not employed. It is noted in the literature that it is difficult to determine which side is ankylosed, and in several cases the well side is operated upon. In a well-studied case, this should not occur. The history will usually assist one. If the condition is unilateral, there is usually some spring on the normal side and a flattening of the diseased side of the face. Careful X-ray pictures, which may have to be repeated several times, will usually clear up the matter.

Conclusions.—In all cases, it is essential to use an exercisor as a post-operative measure. It is advisable to remove most of the condyle. Any pressure made upon the teeth should be upon the canine or those posterior to the canine.

It is non-essential to interpose any material between the divided bones.

Injury to the occipital frontalis branch of the facial nerve frequently occurs. No touch technic should be employed.

MALIGNANT TUMORS OF THE THYROID*

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Of 290 patients with malignant tumors of the thyroid seen at the Mayo Clinic between January 1, 1901, and January 1, 1921, there were nineteen with sarcoma, sixty-two with carcinoma, 102 with malignant adenoma, and with carcinoma not operated on because the condition was considered inoperable on account of extensive growth or metastasis.

Of the nineteen patients with sarcoma of the thyroid, eighteen are known to have died from the malignant condition. One patient could not be reached by repeated letters and has probably died from the malignant condition. Sixteen died from the condition in from two to twelve months after operation. The average duration of the post-operative course in these sixteen patients was about six months. Two lived five and six years, respectively, after operation. The prolongation of life, or perhaps better, the duration of life post-operatively, averaged less than a year. The mortality, then, is practically 100 per cent. It seems that sarcoma of the thyroid progresses to a fatal end, about as rapidly as any malignant condition known.

Of the sixty-two patients operated on for carcinoma, twenty-two are alive with no recurrence. These are mostly patients operated on less than five years ago. Only three of these twenty-two patients have been cured for more than five years. Expressed in percentage, there are 5 per cent. with five-year cures, and 30.6 per cent. with cures of shorter duration. Of course, some of the patients listed as cured for one year may possibly live five years or more. Ten (16 per cent.) of these patients have developed recurrences and will probably die soon from the malignant process, which in this type of malignancy develops very rapidly. Thirty (48.4 per cent.) are already reported dead by replies to circular questionnaires. Twenty-six of the thirty (42 per cent.) died during the first pre-operative year. This fact emphasizes the previous statement that the patients who have carcinoma of the thyroid and have been operated on, die very soon if recurrence occurs.

The results of operations on patients with malignant adenoma are not so discouraging as the results of operations on patients with carcinoma. Thirty-nine of the 102 patients with malignant adenoma (about 38 per cent.) are alive, without recurrence. Eighteen (17.6 per cent.) of the thirty-nine are alive more than five years after operation. These figures are in marked contrast to those concerning patients operated on for carcinoma, since only

* Abridgment of thesis submitted to the Faculty of the Graduate School of the University of Minnesota, in partial fulfilment of the requirements for the degree of Master of Science in Surgery, October, 1923.

CORRECTION—HERBST

In Doctor Herbst's article entitled "Malignant Tumors of the Thyroid," which appeared on p. 488 in the April issue of ANNALS OF SURGERY, a line has been omitted from the first paragraph. The words omitted are "twenty-four with malignant papilloma who were operated on, and eighty-three"; these words should constitute the fourth line of the paragraph, being inserted after "and" at the end of the third line.

three (5 per cent.) of such patients were alive more than five years after operation. Fifty-three (about 52 per cent.) have reported recurrences. Many of them, however, did not have early recurrences, as thirteen occurred in the third year, fifteen in the fourth year, and only six during the first year after operation. Ten (10 per cent.) of these patients have died from malignancy after operation. Of these ten, five lived five years or more, and only two died less than a year post-operatively. It is evident that operation prolongs life much more if patients have malignant adenoma than if they have carcinoma. Likewise the number of five-year cures is greater in cases of malignant adenoma than in those of carcinoma.

Of the twenty-four patients with malignant papilloma, sixteen (66.6 per cent.) operated on report that they are well, with no recurrence after operation. Eight of these are in the group cured for five or more years. Six (25 per cent.) of these have died from recurrence. Four died during the first year after operation, one during the third year, and one during the fourth. Only two have reported recurrences, one two years, the other more than five years after operation. There are nearly twice as many recurrences in cases of malignant adenoma as in those of malignant papilloma, if we count the patients who died from recurrence as well as those who are living with recurrence. There are 62 per cent. of recurrences in the group of patients with malignant adenoma, and but 33.3 per cent. in the group of patients with malignant papilloma. However, we are dealing with very small groups of patients. It would appear that the malignant papilloma is the least malignant of thyroid malignancies.

All of the cases, exclusive of the cases of sarcoma, were studied with special reference to encapsulation of the growths. One group contained all the cases in which the growth had not invaded or broken through the thyroid capsule, the other all those in which the tumors had broken through the capsule and were invading the surrounding tumors. Sixty-two (47 per cent.) of the patients with encapsulated tumors were reported free from recurrence at the various post-operative periods. Fifteen (26 per cent.) with non-encapsulated or infiltrating tumors were reported free from recurrence at the various post-operative periods.

From these figures it seems that encapsulation is as important in malignancy of the thyroid, as in malignancy of any other part of the body. It would seem that encapsulation increases the prognosis almost 100 per cent., because the results in the cases of encapsulated tumors are almost twice as good as in those of non-encapsulated tumors. The results even in the infiltrating cases are worth while, and would argue for surgery even when exploration reveals the growth to be of this type, provided, of course, removal is technically possible.

The foregoing tabulations have a practical value in enabling the surgeon to know by pathologic diagnosis at the time of operation with what degree of malignancy of the thyroid he is dealing. The surgeon will also have some idea of the prognosis. It would seem from this study that all tumors of the

thyroid, except sarcomas, capable of surgical removal, should be considered operable and a thorough operation performed.

The extent of operation varies according to the condition. In cases in which malignancy has been found encapsulated in a single adenoma, the adenoma is enucleated. This operation is considered as radical as extirpation of the whole gland. A few malignant cells in an adenoma of the thyroid are considered quite differently from a few similar cells in the breast, in which a single group of malignant cells would require at least wide excision of tissue surrounding the malignancy, if not radical amputation with axillary dissection and removal of the pectoral muscle. In cases in which there are several adenomas, with or without malignancy, all of the adenomatous thyroid tissue should be removed.

If the growth is diffuse, total extirpation of the gland should be performed in some cases, according to the surgeon's judgment and its technical possibilities. When growth is extensive, infiltrating surrounding structures and causing respiratory embarrassment, palliative operations have been performed to relieve dyspnœa, with surprising results in several instances. These results are interesting. Total extirpation, of course, does not remove the parathyroids, which are left with a small bit of capsule. Formerly by thyroid feeding, and now by accurate means of thyroxin feeding controlled by basal metabolic studies, a patient does not suffer from loss of the secreting tissue. In all ten cases extirpation was performed for extensive involvement of the gland. Seven of the cases were carcinomas and three malignant adenomas. Five of the carcinomas were encapsulated. Two of the five patients are in excellent health without a recurrence two and five years, respectively, after operation; one died from recurrence seven years after operation; one died three months after operation and use of radium and X-rays; and one died two months after operation and X-ray treatment. One of the two cases of carcinoma in which the capsule had broken through, was really inoperable as the growth could not be cleanly removed, and the patient died one month after operation. The other patient lived a year after operation and died of recurrence. In the three cases of malignant adenoma, two of the adenomas were encapsulated and one had infiltrated the capsule. One of the patients with encapsulated malignant adenoma had been operated on elsewhere and has not had a recurrence one year after operation. The other is well and has not had a recurrence five years after operation. The patient with malignant adenoma which had infiltrated the capsule is well one year after operation and radium therapy. Although the cases are few, the good results would seem to argue for radical procedure when indicated.

The results in the next three cases are mentioned only as a matter of interest and not as an argument for extensive surgery in inoperable cases. From one patient a malignant papilloma involving the trachea and œsophagus was removed with a strip of trachea and œsophagus. This patient is well with no recurrence nine years after operation. Another patient, who had a malignant papilloma, about 17 cm. in diameter, which had perforated the skin,

is well with no recurrence four years after radical removal of all the involved tissue, including an elliptical portion of skin. In the third case a malignant papilloma involving the right lobe was extirpated, and, while still at the Clinic, several glands below the angle of the jaw were found to be enlarged, and were removed. These glands had metastatic growths. There have been no signs of recurrence two years after operation. These cases would seem to indicate that apparently inoperable cases are often operable, but they are too few to offer a strong argument. It does indicate, as do also the previous data, that malignant papillomas are the least malignant of the thyroid malignancies.

Radium has been used in a few cases, but not long enough so that accurate deductions as to its value can be drawn. Radium or X-ray or both are now routinely used in conjunction with surgery in all operable malignant cases, and in certain inoperable malignant cases.

Diagnosis.—As has been stated by Wilson, 70 per cent. of the cases of malignancy of the thyroid were missed clinically in this group of cases. On the other hand, in defence of the clinician, it must be said that most of these growths were encapsulated and many impossible to diagnose, clinically, as positively malignant. Since the pathologic diagnosis at the time of operation is sometimes incorrect, the subsequent course in the patient is the deciding factor.

The diagnosis, of course, is easy if the patients have hard, fixed, infiltrating growths with demonstrable metastasis in glands or lungs or elsewhere, hoarseness from involvement of the recurrent laryngeal nerve, dysphagia or pain, or if the patients are of the cancer age and have a steadily and rapidly growing enlargement of the thyroid. It is, however, impossible to make a positive diagnosis of malignancy in the large group of well-encapsulated borderline cases. The factors which should make one suspicious of malignancy are: (1) either a steadily and rapidly growing tumor of the thyroid or a tumor growing slowly and steadily over a period of years in persons of cancer age, between forty and fifty years, (2) the hardness of adenomas of the thyroid with a normal basal metabolic rate in the fifth decade, and (3) the signs of extension of growth mentioned.

A word here is not out of place concerning the slowly growing tumors of long standing which in the first group of cases comprise 30 per cent., in contrast to 25 per cent. of the very rapidly growing tumors. This has not been brought out before except by Wilson in his work on the same group of cases.

Differential Diagnosis.—The following condition we should try to differentiate from malignancy (but if we err it should be on the side of malignancy, and the pathologist should decide at operation): (1) benign adenomas of the thyroid with different forms of degeneration, (2) adenomas with hyperthyroidism, (3) exophthalmic goitre, (4) inflammatory conditions of the gland, (5) tuberculosis of the gland, (6) branchial cyst, and (7) malignancy of aberrant thyroid tissue. All are conditions in which certain facts can be of assistance in attempting to differentiate.

Because of the occasional microscopic demonstration of early malignancy in cases of clinically benign adenoma, malignancy should be considered when a patient of cancer age with adenoma presents himself. One can only say that such a condition is probably not malignant because it has not grown, it is not hard, and because there are no signs of metastasis. A negative X-ray of the chest would not indicate malignancy. A routine X-ray examination is made here of the lungs and chests of all patients with goitre, and the patients in a number of cases which would otherwise have been considered operable have been spared the suffering and expense of a futile operation. Adenomas with calcareous degeneration often suggest malignancy, but, as a general rule, their typical stony hardness will help to distinguish them from malignancy.

Adenomas with hyperthyroidism usually are not malignant. In this series of cases it is impossible to tell how many of the patients had hyperthyroidism, because their basal metabolic rates were not determined. Only a rough estimate is possible, judging each case by its clinical record which includes the history and physical examination. By this method about 3 per cent. of the cases with malignant thyroid disease had definite evidence of hyperthyroidism. Boothby, in a study of basal metabolic rates made in forty-five cases of known malignancy, found definite hyperthyroidism in 22 per cent. Practically, this is of little consequence as malignancy would be found at operation, which is the proper treatment for adenomas with hyperthyroidism.

Exophthalmic goitre is mentioned only because some cases of malignancy in exophthalmic goitre have been reported in the literature. No case has been found here in 5867 cases of exophthalmic goitre. The gland itself in exophthalmic goitre is often quite hard, and, if the other characteristic features of the disease were absent, would readily be suspected of being malignant.

An inflammatory condition of the gland may infiltrate the capsule and feel like a malignant condition, but the history and physical examination will help to differentiate such conditions. With inflammation there will be a history of fever, local heat and possibly redness and swelling, with or without regression, depending on the stage of the condition. If acute, local redness and heat will differentiate it. Malignancy and inflammation may coexist: necrotic and purulent material was discharged by one patient here who died very soon with inoperable carcinoma. Thyroiditis is likely to be diffuse, especially in the early stages, whereas malignancy is more likely to be localized in one portion of the thyroid.

Certain cases of tuberculosis of the thyroid may be diagnosed as malignant. The cases of tuberculosis in the later stages when the gland is not hyperfunctioning are the ones to be differentiated, and this can usually be done if there is a history of a previous exophthalmic phase. Of seven cases of tuberculosis of the thyroid reported by Plummer and Broders, three were considered malignant with no hyperthyroidism, or with only a slight degree of hyperthyroidism.

Branchial cysts may be confused but the location should rule out thyroid disease as these cysts occur outside of the normal location of the thyroid.

Malignancies of aberrant thyroids are differentiated by their location and are very rare.

Metastasis.—Metastasis to bone is most likely to occur from thyroid and prostatic tumors. Müller and Speese, in a group of 257 cases, 238 of which were reported by Ehrhardt, found metastasis to the bone in seventy-three cases. Limocher asserts that bone is more commonly involved than the lungs, and Crotti that metastasis to bone is most likely to be found in cases of malignant adenoma. The metastasis in the cases at the Mayo Clinic does not correspond with these observations. Only two cases with metastasis in bones were found, and these occurred in cases of carcinoma. In nearly all the inoperable cases, the regional lymph-glands were involved, and in many there were growths involving the trachea, œsophagus, vocal cords, and other adjacent structures. In eighteen cases there was metastasis also in the lungs, in five in the liver, in four in the abdomen, in two in mediastinal glands, in two in the brain, in one in the kidney, and in one in the chest wall. Thus the lungs and liver in order were the most frequent sites of metastasis in these cases. The course of the malignancy in the cases considered inoperable at the time the patients were examined in the Clinic has been very rapidly fatal in nearly all. Forty of the eighty-three patients died within three months, twelve within one year, and nine within two years after examination; seventeen letters of inquiry were returned unclaimed, most probably because of death; two patients died of diseases other than malignancy, after examination; one is alive six months after examination and is being treated by radium, one is alive one year after examination, with a slowly growing tumor, and one is alive one and one-half years after examination and being treated by radium and X-ray.

CONCLUSIONS

1. The degree of malignancy in the lesions of the thyroid is according to the order in which they are mentioned: sarcoma, carcinoma, malignant adenoma, and malignant papilloma, sarcoma being the most malignant and papilloma the least.

2. By far the best results are obtained in the cases in which operation is performed before the malignancy has infiltrated the capsule, and this group of cases is the one in which the clinical diagnosis of malignancy is rarely made.

3. Occasional unexpected happy results occur in cases of malignant papilloma found practically inoperable at the time of operation, but in which radical removal of infiltrating growths, and even of glands infected by metastasis, has been practiced.

4. There is no grave contra-indication to total extirpation, so far as myxœdema is concerned, in cases in which all tissue infected by malignancy may be removed.

5. X-ray and radium therapy have not been used long enough nor on a sufficiently large number of patients to estimate their true worth.

6. Metastasis to bone is rare in this group of malignancies of the thyroid. The lungs and liver in the order named are the most common sites of distant metastasis.

7. The possibility of malignancy is too rarely thought of in adenomatous tumors of the thyroid in patients of the fifth decade, and this possibility is not used often enough as an argument to urge operative treatment for these patients.

8. A careful follow-up system should be used in all cases of questionable malignancy, and persisted in for at least ten years before the case is considered benign.

EXOPHTHALMIC GOITRE RESULTING IN BLINDNESS FROM CORNEAL ULCERS

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In reviewing the literature of the last twenty-five years on goitre, I find there are very few references made by either surgeons or internists to corneal ulcers resulting in blindness, as a sequela of exophthalmos in cases of exophthalmic goitre. Most of the references are by the ophthalmologists. Few of the standard books on goitre make any mention of it. Bram refers to it in his book on "Exophthalmic Goitre and Its Non-surgical Treatment."

Corneal ulcers may develop very early in cases of exophthalmic goitre and are not necessarily confined to the long-standing ones. Knapp [1] reports a case of loss of sight in left eye and partial vision in right within five months from onset of enlargement of eyes. Wood [2] reports that dryness of the eyes is one of the commonest complaints made by patients with exophthalmic goitre. In severe cases of exophthalmic goitre one should bear corneal ulceration constantly in mind, as it may appear at any time and has no relation to the duration of the disease.

Treatment.—Local therapy seems to have very little effect on the eye condition and the cases usually progress to complete or partial loss of vision. Sattler [3] says: "Local therapy avails but little." In 1907, he collected and reported forty cases where both eyes were lost; nine, complete in one eye and partial in the other; and fourteen, with complete opacity of one cornea. Irrigations, argyrol instillations, bandaging, tarsorrhaphy, and resection of the outer wall of the orbit have been tried with very little success.

General treatment has consisted in ligation of all the thyroid arteries, cervical sympathectomy, X-ray, and administration of thyroid extract. Rogers ligated the left inferior artery in Knapp's case, with very little result, and later ligated the remaining arteries. The patient lost sight in his left eye but had partial vision in the right—6–200. Cervical sympathectomy has been tried a number of times with practically no improvement of the eye conditions. Bram [4] quotes a case in which the administration of thyroid extract—grs. v, t. i. d.—by family physician, resulted in ocular dislocation with bilateral panophthalmitis and, later, enucleation. Bram states that no general therapy lessens the exophthalmos promptly enough to safeguard the affected cornea.

I have seen no mention made of partial thyroidectomy in cases of corneal ulceration. It would seem to be the logical procedure, as all other forms, both local and general, apparently fail to arrest the progress. De Schweinitz [5] states that partial thyroidectomy meets with great success in the relief of exophthalmos. The following case is reported to show what may be accomplished with surgery, even in neglected cases of exophthalmic goitre.

CASE.—P. G., male, age forty-eight, married; mechanic. Seen April 10, 1923. Chief complaint, goitre. Family history unimportant for disease of the thyroid gland.

Past History.—Had usual diseases of childhood; no history of typhoid, pneumonia, scarlet fever, or rheumatism. Had influenza eight years ago. Patient contracted syphilis at the age of twenty and has been treated for it by different physicians since that time. One physician has been treating him for the past eight years.

Present Illness.—Seven years ago patient became very nervous; noticed swelling in the neck, which was soon followed by enlargement of the eyes and palpitation of the heart. He consulted a physician who kept him under treatment for two years with different medications, but was not improved and was referred to a surgeon for operation. Admitted to hospital and remained five weeks, at which time he had his superior thyroid arteries ligated, but his condition would not permit the removal of the goitre. Three weeks after discharge, he consulted his surgeon, and was advised to return to work. He was not instructed that a second operation was necessary for the removal of the goitre. He then returned to the family physician, and was told that he could be cured with medical treatment. He continued to work at his occupation as mechanic until December 20, 1922.

The following history was taken from the records of the Manhattan Eye, Ear and Throat Hospital, Doctor Thomson's* service, where he was attended by Doctor Skeel.†

"December 21, 1922: Chief Complaints.—Eyes sore and painful; and failing vision.

"Five days before admission, patient was doing some painting and noticed that his eyes began to smart. His eyes remained red the next day but he returned to work in the machine shop. The third day his vision became a little blurred—more so in the left eye. He returned to work the fourth day, and his eyes pained considerably that night. He consulted his doctor, who gave him some drops to use. The doctor saw him the next morning, and sent him to the Manhattan Eye, Ear and Throat Hospital. On his arrival, his vision had failed decidedly, and he was suffering from considerable pain in his eyes.

"Admission note: Marked exophthalmos, O. U., with subconjunctival circumcorneal injection very marked; large deep ulcers on lower half of each cornea, with large slough present on each; remainder of cornea somewhat hazy O. U. Iris O. U. muddy and sluggish. Considerable pain O. U.

"Vision: O. D., large objects; O. S., large objects. Diagnosis: 1. Exophthalmic goitre. 2. Perforating ulcers of cornea, O. U., with iritis."

The treatment consisted of boric irrigations, castor oil instillations, cold compresses over eyes, and bandaging of eyes for protection when compresses were not on. This therapy was continued until January 19th, when patient had one grain of thyroid extract, t. i. d., for two weeks. In spite of this treatment the ulcers were becoming progressively worse.

On February 17th, under local anæsthesia, the right eye was enucleated. The patient was discharged from the hospital on March 2, 1923. The discharge note gave: Vision: O. S., place and shadows.

Physical examination, when seen by me April 10, 1923, a very nervous and excitable man, poorly nourished, with loss of muscle tone and fifty pounds under normal weight. Head and neck: Right eye enucleated. Left eye can see only shadows. Neck: Two scars over upper part of thyroid gland. Patient has a goitre with symmetrical enlargement and definite thrill on palpation. Chest: Poorly nourished; no râles heard on auscultation. Heart: Apex in 5th interspace, in mid-clavicular line; no murmurs heard;

* I am indebted to Dr. E. S. Thomson, for the privilege of using the records of the Manhattan Eye, Ear and Throat Hospital on this case.

† In a personal communication from Doctor Skeel, he says he "does not think the positive Wassermann had any direct bearing on the production of the corneal ulcers."

marked arrhythmia. Pulse, 124. Blood-pressure, 150–90. Abdomen: Liver not palpable. Extremities: Fingers have a *fine tremor*. Patellar reflexes: Normal.

Admission to hospital was advised and accepted, April 26, 1923. Laboratory findings.—April 27, 1923. Urine: Albumin, 2+; sugar, negative; acetone and diacetic acid, negative. Microscopic, negative. The blood count showed: Erythrocytes, 4,400,000, and otherwise negative. Chemical blood analysis: Normal. Basal metabolism, 64 per cent. above the average normal.

The patient's temperature varied from 99° to 103.5°, with pulse varying from 90 to 134. The average temperature was 101–2, and pulse 120.

Treatment.—Absolute rest in bed, with forced fluids and carbohydrate diet; tincture of digitalis, M. x, t. i. d.; luminal, grs. 1.5 q. 4 h.; pancreatic substance, grs. ii, q. 4 h.; codeine, grs. ss, o. n.

Two weeks later, the basal metabolism was 47 per cent. above the average normal.

Operation on May 16, 1923. Gas oxygen anæsthesia; partial resection of thyroid gland, bilateral, leaving about one-seventh of gland substance. *Convalescence:* After the first twenty-four hours, the patient's temperature remained under 100.6°, and he was out of bed on the sixth day and discharged on the ninth.

Follow-up: Patient has gained steadily and progressively in strength and vitality since leaving the hospital. When last seen, October 3, 1923, his weight was 148 pounds, as against 90 pounds, at the time of operation. Pulse, 80. Temperature, 98.4. Basal metabolism, 3 per cent. above average normal.

Patient's statement at this time, "Feels normal in every way, and only complaint is lack of vision."

CONCLUSIONS

(1) Corneal ulcers may develop at any stage in exophthalmic goitre.

(2) Local and general therapy have given very unsatisfactory results.

(3) Partial resection of the thyroid gland, seems to offer the best chance of arresting corneal ulceration in exophthalmos, resulting from exophthalmic goitre.

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A CONTRIBUTION TO THE STUDY OF FISTULÆ AND CYSTS OF THE NECK*

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The congenital fistulæ and cysts of the neck, first attracted attention because of their presence in the so-called beauty lines of the neck; particularly if the blemish chanced to occur in a female otherwise normal. At a later period the anatomists and pathologists began to describe them, viewing these embryonic defects as are curiosities. The final stage in the study of these cases was effected in the past thirty years, through the combined development and disclosures of embryology, histopathology and modern surgical technic. A prominent American surgeon recently recommended the study and basic understanding of embryology as one of the foundation stones of surgical training. Few problems in surgery illustrate the latter statement more forcibly than does the development of our knowledge and treatment of the congenital fistulæ and cysts of the neck.

This study is based upon the personal observations and operations of two complete lateral fistulæ, two thyroglossal cysts and fistulæ and one blood cyst of the neck. The rarity of these cases and the difficulty in obtaining specimens makes it anything but easy for the individual surgeon to pass critical judgment. A number of classifications have been advanced by different observers, based on the embryology of this region and the histopathology of serial sections of excised fistulous tracts and cysts. Clinically, however, we must often content ourselves with a diagnosis of cyst or fistula of the neck and try to formulate its course and the underlying pathology of its genesis from our knowledge of embryology. The classification of the congenital fistulæ and cysts of the neck is extremely difficult. No attempt has been made in this contribution to include the numerous classifications of these congenital anomalies, because of the lack of unanimity of opinion and the questionable utility of such grouping. The subject has been extensively studied by many observers and recently by Gaetano, to whom the reader interested in the many classifications is referred.

The persistence of portions of the branchial system of cavities and the persistence of a tract or cells dislocated in the descent of certain viscera may give rise to congenital cysts and tumors.

The development of median congenital fistulæ or cysts is due to the persistence of the median thyroglossal duct. The latter in accord with the usual conception exists as a cord with a central lumen, developing from the

* Read before the Philadelphia Academy of Surgery, January 7, 1924.

foramen cæcum of the tongue and opening into the oral cavity. The persistence of the whole or part of the thyroglossal duct leads to the development of a complete or incomplete median fistula.

Wenglowsky has called attention to the fact that the thyroglossal duct as observed in many embryological serial sections does not disclose the presence of a lumen, the examination of embryological specimens of various ages usually fails to disclose a canalized duct. The thyroglossal duct loses its lumen very early in the embryo, the occurrence of this lumen, however, is extremely variable, even before 5 mm. or about a 22-day embryo. It becomes drawn out to a solid cord, which cord is broken in embryos between 6 and 7 mm. (25 to 27 days). It would appear, therefore, that the early lumen of the thyroglossal duct which is inconstant is not a factor of great importance in the development of the thyroglossal fistulæ. Furthermore, it is well to remember that a complete thyroglossal fistula is extremely rare. So much so that some observers have expressed the opinion that complete thyroglossal fistulæ never occur.

The thyroglossal duct as usually observed exists only as an epithelial cord. The rapid growth of the thyroid anlage from the oral cavity to the depth of the neck may take with it as it descends ciliated cylindrical and squamous epithelium from the neighboring structures. The latter cells dislocated from their usual site remain as cell rests. It is the belief of the writer that it is these groups of cells which exhibit a peculiar tendency to canalization and are the foundation for the development of thyroglossal cysts and fistulæ. In support of this theory the following facts are adduced: First, the absence of the lumen in the thyroglossal duct. Second, the existence of fistula with more than one tract. The occasional occurrence of lateral branches communicating with the main tract is well known. Third, the observation of ciliated, cylindrical and squamous epithelium commonly present in one fistula. Fourth, the frequent presence of epithelial cell rests in the body of the hyoid bone, in the lobes of the thyroid and in the thyroglossal duct. Fifth, the great rarity of complete thyroglossal fistulæ.

Lateral Fistula.—The occurrence of the lateral or branchial fistulæ as the latter name indicates arise from one of the visceral arches. A large group of these take origin from the second visceral arch. As a confirmation of their development from the second visceral arch is the presence of the inner opening in the tonsillar fossa or in the palatopharyngeal arch. It is well to remember that the third and fourth arches are very rudimentary in man.

Although the second arch is the most common site for the origin of lateral fistula, it is possible for the third and fourth arches to be the nidus for their development. The sinus præcervicalis which is produced by the sinking in of the arches and the included furrows in the lower part of the future neck region, usually entirely disappears on coalescence of the bordering parts. Sometimes such union is defective, the imperfect closure resulting in a

permanent fistula situated at the side of the neck known as cervical fistula by means of which communication is established between the pharynx and the exterior of the body. When entrance into the pharynx through the fistula is possible, it is probable that the septum has been destroyed as the result of absorption or the mechanical disturbance following the use of a probe.

Lateral cervical fistulæ may have their origin in the remnants of the thymopharyngeal duct. The embryonic thymus anlage develops as the outpouching of the third branchial arch, the duct persisting as a fine cord from the third branchial pouch to the thorax. The persistence of a whole or part of the duct with the additional occurrence of an inflammatory process, leads to the development of a complete or incomplete fistula. As evidence in favor of the latter theory as the source of lateral cervical fistula is the following facts: 1. The location of the inner opening behind the arcus palatoglossus and below the tonsillar fossa which is suggestive evidence of their development from the third arch. 2. The common presence of the rests of the thymopharyngeal duct in the cadavers of children, partly as epithelial rests, partly as cysts, and partly as fine canals which are lined by ciliated, cylindrical or squamous epithelium and frequently typical thymus tissue remnants in the fistula.

It is the belief of the writer that the remnants of the thymopharyngeal duct, indicating the course of the caudal migration or descent of the thymus gland from the third pharyngeal pouch to its site in the thorax, offers a tenable explanation for many of the lateral fistulæ of the neck. For like the thyroid, the thymus seems to have a phylogenetic tendency to move toward the thoracic region. Furthermore, while a part of the thymus is of branchial origin, and the organ is commonly classed with the ductless glands, both its finer structure and the course of its growth indicate a close relationship with the lymphoid organs. The lymphoid character of the thymus makes it more susceptible to infection and inflammation without which external fistulæ almost never occur. In both of the writer's cases of lateral fistulæ the inner orifice was located below and inferior to the tonsillar fossa; facts in favor of their origin from the long epithelial tube of the thymus anlage. This conception of the origin of lateral cervical fistula, offers a tenable explanation of the occurrence of the external orifice low in the neck and in the region of the suprasternal or jugular notch.

In furtherance of this theory, it is well to remember that the potentiality of lumen formation or canalization is a normal developmental process in many embryonal tissues. Witness, for example, the early nasolacrimal duct, the ducts of the liver, the ducts of the mammary gland, etc., structures which early in the embryo are solid tissues, the development of the lumen being a later stage of their growth. It would appear, therefore, that embryonal cell rests may under certain stimuli at times undergo canalization or lumen formation resulting in an abnormal canalized tract or cyst. Similarly, we occasionally observe the reverse process, that is, congenital occlusion due to

epithelial proliferation, particularly in the small and large intestine, at times in the nares or choanæ and other structures of the body. The writer has observed cases of congenital occlusion of the ileum, the duodenum and the colon.

Discussion.—The fistulæ are usually divided into complete and incomplete, the latter type rarely appearing with only an inner opening. The outer or external fistulous opening may appear intra-uterine or postpartum. The fistulæ almost invariably result from inflammation of the fistulous tract and its lumen, which induces perforation of the skin, the latter constituting the external or cutaneous orifice. It is not uncommon for the cutaneous opening to first appear following an attack of one of the acute infectious diseases of childhood. In two of the writer's cases the external opening first appeared during the convalescence of scarlet fever. The presence of adenoid and lymphoid tissue, particularly in the lateral fistulæ makes these structures liable to inflammatory processes. The external opening may be primary if its origin is from the second arch, the orifice usually lying at the median border of the sternomastoid muscle between the hyoid bone and the sternum. In the median fistula, the external orifice is usually in the midline between the hyoid bone and the thyroid gland. The inner opening of the lateral fistulæ from the second arch may be in the tonsillar fossa, ventral and cephalic to the tonsillar fossa or dorsal to the soft palate in the fossa of Rosenmüller. The presence of the inner orifice below or caudal to the tonsil suggests the origin of the tract from the third arch or the thymopharyngeal duct. The inner orifice of the median fistula when present is in the foramen cæcum of the tongue.

Diagnosis.—The diagnosis is usually easy to establish. The patient presents a small cutaneous opening discharging a serous or seropurulent exudate. The amount of discharge varies from 1 drop to 1 c.c. daily. Frequently there is a co-existent eczema of the skin surrounding the external orifice. In the lateral fistulæ and at times in cases of median fistulæ or cysts, the tract can frequently be palpated as a distinct vertically coursing cord in the neck. If the outer opening is elevated on swallowing, it usually means a complete fistula. Less commonly elevation of temperature and difficulty in swallowing are among the symptoms present. The injection of one of the various coloring fluids such as methylene blue is helpful not only for the purpose of diagnosis, but also as an aid in outlining the extent and course of the tract. It is well to remember, however, that the fistulæ usually become friable, small and attenuated as they course cephalically. The use of a fine probe is usually not advisable, (1) because of the infection present. The most common complaint which induces these patients to seek surgical aid is the presence of infection or retention of secretion (2) the danger of false passage, (3) practical impossibility of traversing the upper limit of the tract, (4) danger of injury to important neck structures. The presence of epithelial cells in the secretion is in the favor of fistulæ and is evidence against a broken-down tuberculous gland as a cause of the cutaneous opening. Its congenital origin and their hereditary tendencies are additional confirmatory data.

Topography.—A fistula of second branchial arch which is by far the most common is covered by skin, superficial fascia, platysma and the superficial layer of the deep fascia of the neck. It courses along the medial border of the sternomastoid muscle to the greater corner of the hyoid bone. From the latter site it passes over or superficial to the common carotid artery, and then if development is normal between the internal and external carotid arteries and ventral to ninth and tenth cranial nerves to the side of the pharynx. At the level of the greater cornu of the hyoid bone, the fistula takes a turn medial and dorsal, and it is only to the latter site that a fine probe can be passed. Similarly the injection of one of the colored identifying fluids, usually does not pass beyond the greater cornu of the hyoid bone. In one of the writer's cases, however, the injected color fluid appeared in the pharynx following its introduction at the external aperture disclosing definitely a complete type of fistula. A fistula of the third visceral cleft lies between the common carotid artery and the vagus as well as between the glossopharyngeal and the superior laryngeal nerves. Fistulæ of the fourth visceral cleft must bend around the subclavian artery on the right side and wind around the concavity of the aortic arch on the left side. The *median fistulæ* course over the sternohyoid and sternothyroid muscles and are usually related to the posteroinferior surface of the body of the hyoid bone on its way to the foramen cæcum. The fistulæ may, however, terminate at this point, or may even pass through the body of the hyoid bone to disappear in the musculature of the floor of the mouth. The tract becomes attenuated, small and friable in its cephalic portion, and it is usually impossible before operation to know accurately its cephalic limit.

Treatment.—The majority of the operations for the cure of the congenital fistulæ of the neck are unsuccessful unless the epithelial-lined tract is completely removed. The inner opening is cut around if possible and sutured. The utilization of methods of treatment other than surgery, only results in recurrences.

The injection of bismuth for X-ray and introduction of methylene blue immediately before operation are helpful in outlining the course of the fistulous tract.

The median or thyroglossal cysts were excised by the method advocated by Gaetano and Sistrunk. As a rule the cyst below the hyoid bone is easily excised, but cephalic to the hyoid the tract becomes friable and small, so that it is easily broken off and consequently difficult to remove. As Sistrunk and others have stated, better results are obtained when no attempt is made to isolate the duct above the hyoid bone. Therefore, instead of attempting to isolate the duct, the tract is cored out, removing with the duct the tissues surrounding it for a distance of about one-eighth inch on all sides between the hyoid bone and the foramen cæcum in a line. At the level of the hyoid bone, the tract as noted above may pass through it or it may be found passing in front or behind it. The muscles attached to the centre of hyoid are separated and a quarter of an inch of the hyoid bone is removed. The dissection

is continued in a dorsocephalic direction toward the foramen cæcum, removing with the duct a portion of the hyoid bone, a portion of the raphé joining the mylohoid muscles and portion of each geniohyoglossus and the foramen cæcum. The opening in the mouth is closed and several sutures used to approximate the geniohyoid muscles. The tissues surrounding the cut end of the hyoid bone are then drawn together by chromic catgut sutures so as to approximate the ends of the bone. A small rubber drain is introduced to this point and the skin closed around it. In two cases in which the above procedure advised by Sistrunk was carried out, there were no ill-effects following the removal of the hyoid bone or any serious infection following the opening made into the mouth.

Lateral Fistulæ.—Similar to median fistulæ can only be successfully cured by radical excision of the suture tract. Here again it is necessary to bluntly dissect out the tract, particularly in the region of the great vessels. In cases where the tonsillar fossa is suspected as the site of the inner orifice, a tonsillectomy should precede the excision of the tract. The lateral fistulæ similar to the median fistulæ may be dissected out easily and without difficulty, in the caudal part of their course, *i.e.*, below the digastric muscle. But above this, the tract may be adherent and is in close relation to the important neck structures. In some of the fistulæ it is impossible to dissect them away without destroying important neck structures, a procedure which the primary condition does not justify.

In one of the writer's cases the external carotid artery was distinctly behind the fistula and had no attachments to its wall.

Von Hacker's method consists in the inversion or invagination of the fistulous tract into the oral cavity and the inverted portion excised.

Complete inversion of the fistulæ can only be successfully carried out (1) when the fistulous tract is movable, (2) when adhesions are absent to the surrounding structures. At times the presence of an excessive amount of connective tissue, muscle, cartilage or developing bone in the wall of the tract may interfere with the successful inversion of the sac. Von Hacker, Helferich, Whitacre and O'Dowd, and in one of the writer's cases, the procedure was successfully carried out. For adherent cases, Konig's method seems well suited. The operation was performed successfully in one patient as follows: The dissection of the entire fistulous tract was carried upward to a point immediately above the digastric muscles and separated from its attachment to the pharyngeal muscle. The blunt end of a probe was passed cephalically from the upper end of the operative wound in the neck into the mouth to the inferior anterior border of the right tonsil. A small incision was made in the oral mucous membrane over the probe. The distal end of the fistula was tied to the open end of the probe with silk and the probe drawn in the mouth, the fistulous tract following was drawn into the oral cavity until it seemed to be on a stretch. The everted portion of the fistulous tract was cut away and the portion remaining was fixed to the mucous membrane of the mouth by two chromic catgut stitches. The fistula now has both

openings in the mucous membrane, the inner end in Rosenmüller's fossa and the other in front of the tonsil instead of the skin. There is thus produced an open canal beneath the oral mucous membrane in which retention cannot take place. Traction is made on the tract until it seems to fray away. Caution must be exercised not to exert excessive traction on the fistula in the act of inversion because of the danger of tearing it away. The latter accident occurred in one of Konig's early cases.

The cases forming the basis of this paper were operated upon by the writer in the service of Doctor Nassau, at the Mt. Sinai Hospital, and I am indebted to Doctor Nassau for his courtesy in allowing me to report them.

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POST-OPERATIVE PULMONARY COMPLICATIONS*

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A review of the previous Annual Orations before this Academy finds the subjects following two definite lines, (1) the philosophical and (2) the technical. In choosing a subject for this occasion we promptly eliminated the philosophical. Your intimate knowledge of our work and limited years of experience would embarrass any attempt upon our part at the retrospective or perspective. The technical subjects presented have been based upon original research or have visioned new fields in surgery. Again we were forced to admit our limitations. Our final decision has been to discuss such a commonplace subject as post-operative pulmonary complications and we hope you will bear with us in the presentation of one of our hobbies.

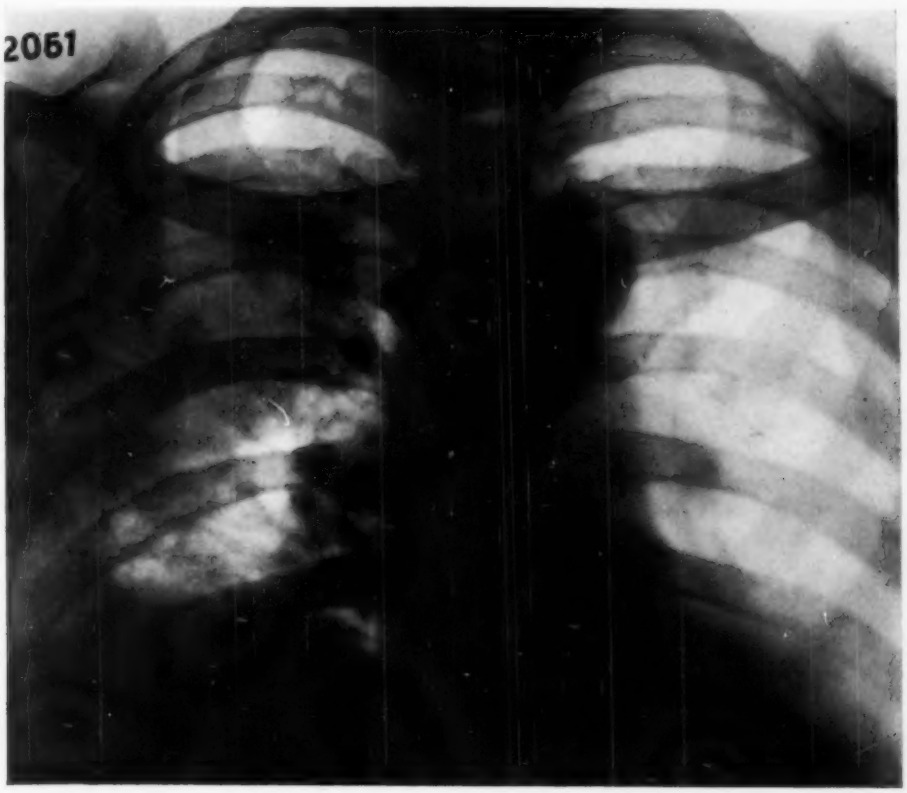
Our interest in post-operative pulmonary complication began when in charge of a department of anæsthesia. This was at a time when all such complications were considered the direct result of the anæsthetic and incidentally the skill of the anæsthetist. The resentment of youth may have been the real incentive which stimulated an investigation of this problem at that time. Although the work was never published it served to convince us, and a few of the staff surgeons, that there were many etiological factors other than anæsthesia concerned in these embarrassing complications. Curiously anæsthetists are still passively accepting this easy explanation. Cutler [1] states that it is unfortunate that anæsthetists and anæsthesia should bear the blame of pulmonary complications following anæsthesia and operative procedures, when the facts seem to exonerate both in the majority of cases. This certainly is in accord with the experience of many surgeons.

The literature of the last few years has shown a very rapid increase in the incidence of these complications, and the present figures are such as to demand a serious consideration of the problem by both the surgeons and the anæsthetists. Undoubtedly this increase in the morbidity is largely, if not entirely, due to more careful physical examinations and better records so that the following figures more nearly represent the situation than any of our older statistics. Cutler in two of his reports, which were three years apart, shows a marked increase in his later group. It now seems well established from many sources that 1 in every 50 patients operated upon develops a pulmonary complication and one in every 150 to 175 developing such complications die, a morbidity of between 3 and 4 per cent. and a mortality of about 0.6 per cent. Pepper,[3] McKesson,[4] Cutler and Hunt,[2] Norris.[5] With such figures the value of our generally accepted anæsthetic risks, ether

* Annual Oration in Surgery, 1923, before the Philadelphia Academy of Surgery.

1–16,000, chloroform 1–3000, ethyl chloride 1–12,000, nitrous oxide 1–300,000, appear useless in estimating operative risks.

We can no longer regard all post-operative pulmonary complications as post-anæsthetic sequelæ, nor assume that the only risk of post-operative pulmonary complication arises in the anæsthesia. Long before the days of the routine use of general anæsthesia we find Norman Cheevers [6] writing in Guy's Hospital Reports, "that pneumonia is the most frequent cause of



Right Left

FIG. 1.—Pulmonary embolus and infarction. Right middle lobe. Symptoms developed on 18th day following a supracervical hysterectomy for uterine myofibroma. Infarcted area triangular in shape with base toward periphery and apex toward hilus of lung. Radiogram taken by Dr. D. R. Bowen, Pennsylvania Hospital, Philadelphia. Robert G. Le Conte.

death after surgical procedures." The literature contains many references to the effect that the incidence of these complications is as great, and many claim greater, with local anæsthesia as with general, though the mortality when following general anæsthesia is slightly higher than in local. Mandl,[7] Gottstein,[8] Mikulicz,[9] Henle,[10] Sauerbrock.[11]

Instead of the anæsthetic being considered the most important factor (and the only one by many) in these complications, its greatest effect can only be contributory, and it should be considered with such other contributing factors as infection (either pre- or post-operative), preëxisting lung disease,

old age and debility and the chilling of the body, all of which have been so carefully studied by Whipple.

It is now generally accepted that the site of the operation and the character of the procedure are the constant and all-important factors. The relation of the operative field to the diaphragm bears a direct relation to post-operative pulmonary complications and statistics show this relationship is the most constant of all etiological factors. Cutler and Hunt [2] give perhaps the highest

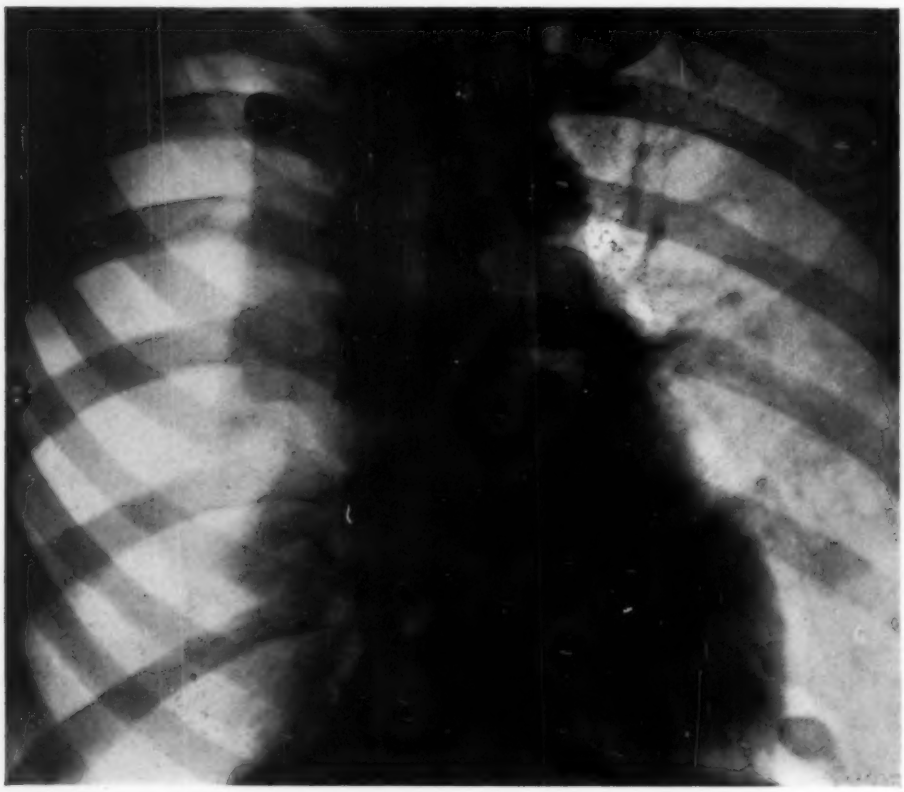


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FIG. 2.—Spontaneous pneumothorax with compression of the right lung occurring in a patient with chronic pulmonary tuberculosis. Note the character, size and position of the shadow cast by the compressed lung. Compare the density of the shadows in the right thorax, containing free air in the pleural cavity, with that of the left in which air is confined within the lungs. The diaphragm is markedly depressed because of increased intrathoracic pressure. Radiogram taken by Dr. D.R. Bowen, Pennsylvania Hospital, Philadelphia.

figures. In a group of 63 cases of post-operative pulmonary complications 43, or 68 per cent., followed laparotomies. Mandl [12] reports a general morbidity of 8 per cent. following operations upon other parts of the body and 14.5 per cent. after abdominal operations. Norris [5] a general morbidity of 1.1 per cent. and 4 per cent. after laparotomy. Pasteur [13] a morbidity of 1.8 per cent. after operations upon the urinary bladder, while there was 13.4 per cent. after operations upon the stomach and 11.0 per cent. following operations upon the liver and gall-bladder.

In addition to the necessity of abandoning our complacent acceptance of anæsthesia as the sole cause of post-operative pulmonary complications, the work of Cutler also makes it necessary for us to abandon the all-inclusive diagnosis of "pneumonia" for these complications. With the more accurate physical examinations his work has stimulated there is a surprising decrease in this diagnosis of post-anæsthetic pneumonia. In the same group of sixty-three cases, previously referred to, Cutler demonstrated thirty-two as being caused by pulmonary embolism and infarction. Rupp [15] found at autopsy in 13,000 post-operative cases, 5 per cent. having demonstrable emboli and infarctions in the lungs. In our immature work years ago, embolism and infarction were found very frequently post-mortem, but their significance was not appreciated at that time. To Cutler belongs the credit of demonstrating this condition and calling attention to it. The onset is usually abrupt, the physical signs are characteristic and febrile changes are sudden, except when the emboli occur in an aseptic field. In septic emboli the clinical picture may simulate pneumonia, or lung abscess may result. When the clot is sterile the resulting changes are characteristic of minor pulmonary infarcts. "From the second to the fourth day there is usually sudden pain on respiration followed by expectoration in about one-half the cases. The sputum is often blood-stained." "Preceding the onset of this symptom there is usually a rise in pulse, temperature and respiration, and with the pain these may increase." "Immediate auscultation of the chest reveals one or more small areas covered with fine râles over which there is some impairment of breath sounds and, if the focus is sufficiently large, some change in fremitus." "When pain is present a friction rub may be the most distinct sign." "It must be remembered that a friction rub results only when the area of the lesion reaches the periphery of a lobe." It also must be understood if we are to recognize all these lesions that some in the smaller thrombi do not cause sufficient pathology to give those physical signs. Cutler and Hunt advise Röntgen-ray studies as of the greatest value. Invariably they appear as small flurries of consolidation, which from time to time will take the form of a cone-shaped shadow with its base out. Röntgen-ray studies, moreover, should be made immediately, since these lesions chiefly represent merely a change in blood distribution and soon clear up. A definite resolution is complete as a rule within six to seven days. Of course, this process will vary according to whether the emboli are aseptic or septic and also upon the size of the embolus and the vessel in which it lodges. Thus you sometimes will have definite massive areas of infarction and in the lantern slide being shown (Fig. 1) there was pulmonary infarction which was distinctly demonstrable in the X-ray. In conclusion Cutler and Hunt with many others now believe that embolism from the operative field is the primary factor in all post-operative lung lesions and that all others are secondary and contributing factors only. Embolism is used in the sense of the transfer of small particles, which may or may not be sterile, from the operative field to the lungs, by either the lymphatic or blood channels.

It is our belief that pulmonary embolism and infarction will be found in a much larger proportion of post-operative pulmonary complications than has been reported up to the present time (Cutler 50.7 per cent.) as the character of our physical examinations improves. The importance of this phenomenon has been admirably presented by Cutler from whose reports we have freely quoted, and need take no more of our time.

There is, however, another post-operative pulmonary complication whose

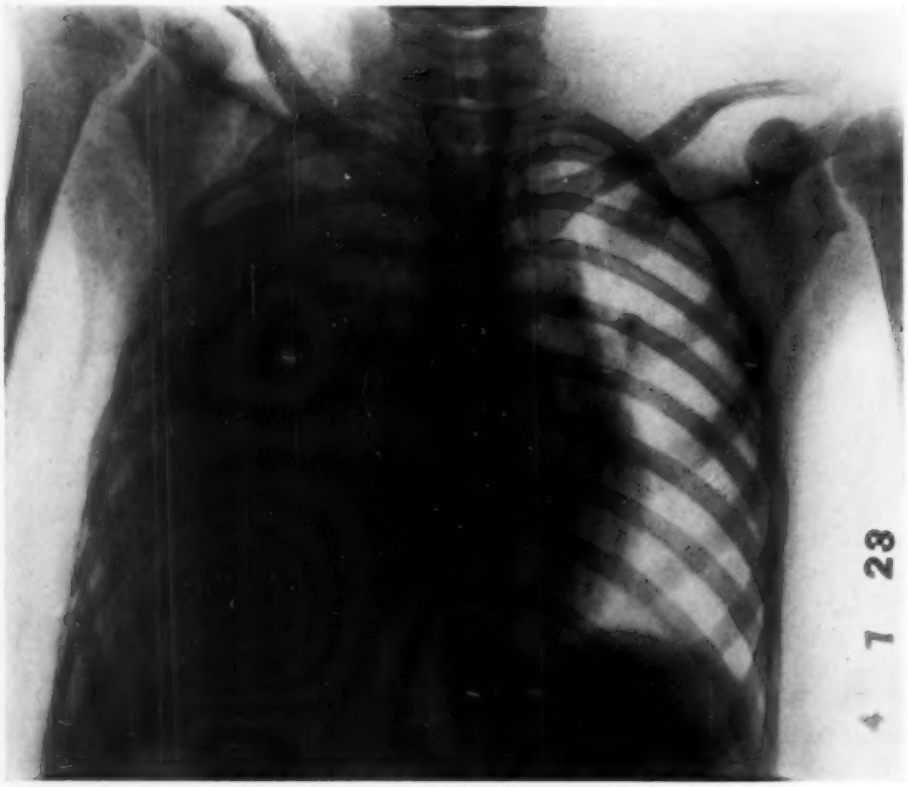

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FIG. 3.—Acute, massive streptococcic empyema in a child of 11 years. Note the uniform opacity of the shadow cast by the fluid. The great lateral displacement of the heart to the opposite side and the downward displacement of the diaphragm on the affected side resulting from increased intrathoracic pressure. Case of Dr. R. Regester and Graeme Mitchell, Children's Hospital, Philadelphia. Radiogram taken by Dr. Ralph Bromer.

incidence is probably constant and may be as great as embolism and infarction, to which we wish to devote the rest of the time. *Post-operative Massive Collapse of the Lungs.*—Attention to this phenomenon was first called by Pasteur in a paper entitled "The Respiratory Paralysis after Diphtheria as a Cause of Pulmonary Complications."[16] In 1910,[17] he stated that there was a close connection between the mechanism producing collapse of the lower lobes of the lung in post-diphtheritic paralysis and that underlying the collapsive attacks following operative procedures. In 1914,[13] he records a group

of 201 post-operative lung complications, in which he recognized 12 cases of massive collapse or a proportion of 6 per cent. Since this report 28 cases have been recorded in literature to which we add 2, making a total of 42. We feel that a general recognition by surgeons of this possibility and a systematic search will greatly increase this incidence of 6 per cent. suggested by Pasteur. That in the last year we have encountered two definite cases and a possible third would suggest this. In several of the clinics in this country, routine X-ray examinations of the lungs are being made at the present time after all major operative procedures.

Undoubtedly varying degrees of pulmonary collapse occur and Briscoe [18] states his belief that the large majority of post-operative pulmonary symptoms are entirely due to varying degrees of pulmonary collapse. Pasteur [13] takes exception to this definition of the condition and would have us confine the term collapse to the condition of massive collapse, in which the lung is completely deprived of its air. When not completely airless, he suggests the term partial deflation. This seems to us unnecessarily confusing. Further, it would also exclude its constant presence as a modifying and often a determining factor in such other conditions as pulmonary embolism and infarction. To us its importance as a post-operative factor lies not in the occasional massive collapse we encounter, but that it always occurs in varying degrees after operative procedures, trauma and other conditions of which we will speak later. However, only massive collapse of one or more lobes has been recognized up to the present time. A brief recital of our own cases will probably present the phenomena in the clearest way and make possible a detailed discussion. The usual phenomenon is as follows: A few hours to as long as seven days after a surgical operation, usually abdominal, the patient suddenly presents the symptoms of a catastrophe. It is impossible at first to localize the condition, the thorax after a short time engages one's attention. Acute dilatation of the heart, coronary embolus, pulmonary embolism or pulmonary infarction are the common preliminary diagnoses. A more careful examination may suggest pneumothorax. There is usually only a moderate febrile reaction unless there is coincident infection. There may or may not be an increase in respiratory rate, sometimes reaching 30 or 40. A pulse rate and a respiratory rate directly related to the febrile reaction are to be expected, but otherwise they are remarkably undisturbed. The physical signs of the chest are perhaps the most characteristic findings. Upon inspection there is diminished or even absent respiratory movements of the chest wall over the affected area. The intercostal spaces apparently are hollow and very much narrower than upon the normal side. The cardiac impulse is seen displaced toward the affected side (just the opposite to that one finds in a pneumothorax or effusion). The apex has a tendency to tilt outward and upwards, so that the apex of the impulse of the heart beat may often be felt in the axilla (this is particularly true when it occurs on the left side). In one of our cases, right-sided, it reached the right anterior axillary line and was first diagnosed by the house officer as a case of dextrocardia (a very

frequent preliminary diagnosis). The dome of the diaphragm on the affected side is abnormally high and immobile. The high diaphragm is readily detected by percussion in the left-sided cases. On the right side, however, percussion is not so reliable but X-ray examination yields definite evidence both as to its position and immobility. These symptoms are common to all cases, in other words, physical symptoms which indicate a falling into the pleural space of the surrounding structures, namely, those of the mediastinum and

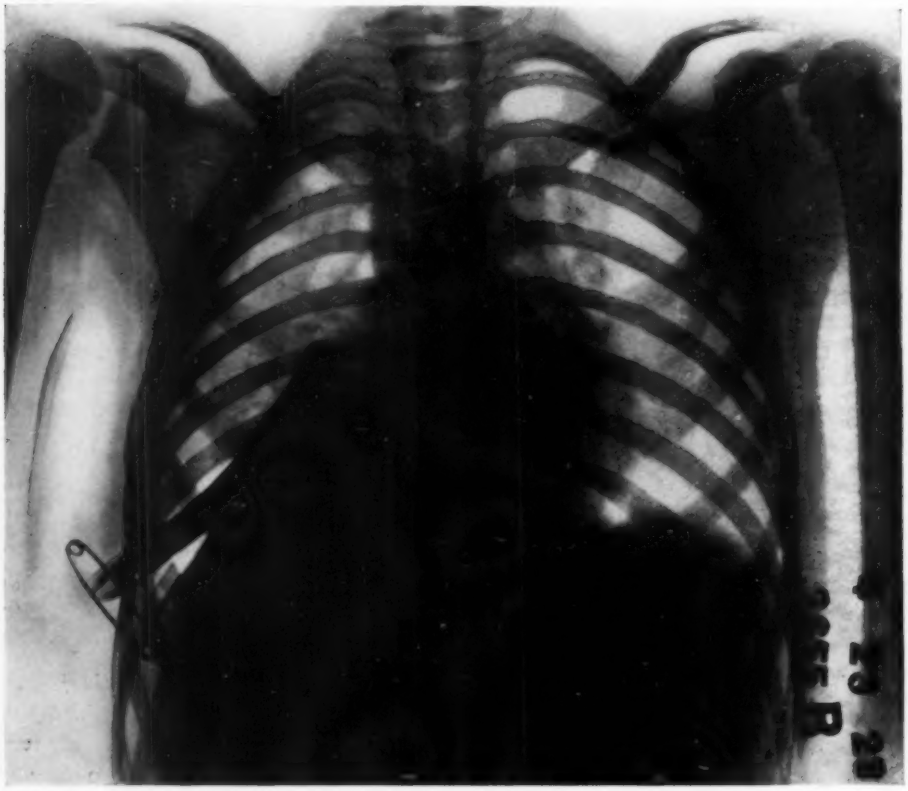

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FIG. 4.—Same patient as Fig. 3, forty-eight hours after thoracotomy by intercostal incision. Left lung still unexpanded after its compression; heart and diaphragm returning to normal positions. Radiogram taken by Dr. Ralph Bromer. Childrens' Hospital, Philadelphia.

diaphragm. A further study of physical signs divides the cases into two distinct groups. In both, dulness on percussion is present over the affected side and may extend as high as the clavicle; this is usually posterior but may be anterior. It corresponds to the area of the collapsed lung. The pleural space unoccupied by the collapsed lung is hyperresonant and may be tympanitic. In one group the vocal fremitus is diminished or absent, while in the other it is increased. In the group where the vocal fremitus is diminished or absent, the breath sounds are also diminished or absent, but when increased the breath sounds are loudly tubular or amphoric in character and broncho-

phony and pectoriloquy are also extremely well marked. This difference in the physical signs is probably dependent upon the patency of the bronchi. When there is a large proportion of air in them there is an increase in breath sounds which are loud, tubular, amphoric in character and bronchophony and pectoriloquy are present. One will readily see that the physical signs in the lungs are those commonly attributed to pneumonic consolidation but, if anything, the signs are even more marked, especially the tubular and amphoric character of the breath sounds. One of the main reasons why massive collapse of the lungs is so frequently overlooked, is that the tubular breathing is so extraordinarily well developed that its mere presence is at once regarded as conclusive evidence of the existence of pneumonic consolidation. Due regard to the other signs, namely, cardiac displacement, should make the diagnosis clear. In the type of case where there is dulness on percussion and diminished or absent vocal breath sounds the diagnosis is more difficult, unless adequate stress is laid upon the displaced position of the cardiac impulse. Broadly speaking, this type of case in which the bronchi are not patent is usually found in the early stages of the condition, while the patent bronchi are found in the later stages of expansion. In one of our cases the breath sounds and the transmitted voice when heard through the stethoscope were almost deafening. Râles and adventitious sounds may be present but are often absent throughout the entire process. Again they may be abundant, especially in the latter stages of the disease when the lung is reëxpanding. When, in rare cases, inflammatory complications develop in the collapsed lung, the presence of adventitious sounds will coincide with the lesion developed, but they are not the essential signs of massive collapse. The cardiac displacement is the most characteristic physical sign and the condition cannot be diagnosed with certainty unless this sign is present. This marked displacement of the heart is rarely if ever accompanied by cardiac murmurs. Though the displacement is mainly lateral, in cases where the whole lobe or the upper lobe is involved the displacement is also upward, so that the maximum impulse may be felt in the third interspace or behind the rib. The Röntgen-ray corroborates all these physical signs and will be of the greatest aid when the lesion is on the right side. The lung shadows on the affected side will be more or less opaque and suggest a purulent pleural effusion in its degree of density. The extent and density of this shadow will, of course, vary with the amount of lung involved and the degree of airlessness. As the air returns this opacity gradually disappears, the opposite to a pleural effusion. Instead of an increased pleural pressure, as in pleural effusion, pushing away the heart and diaphragm, there is a negative one and the heart and diaphragm encroach upon or are drawn into the pleural space. The displacement of the heart toward the affected side is usually very marked and the dome of the diaphragm ascends to an unusual degree. The X-ray interpretation in one of our cases was a subdiaphragmatic abscess. Rose-Bradford [19] says, " that its being a complication of other diseases and injuries probably explains its being so frequently overlooked, its physical signs usually

being attributed to other causes." There is a surprising dearth of references to this condition in the literature of general medicine. Norris and Landis [20] speak of massive collapse of the lung as a complication of pneumonia. Rose-Bradford [23] refers to it as a possibility in pneumonia and reports an autopsy in one case where there was a collapse of the lower lobe and pneumonia in the upper lobe. Tidy [21] reports an undoubted case of a massive collapse of the entire right lung in a healthy man twenty-nine years of age who was suddenly

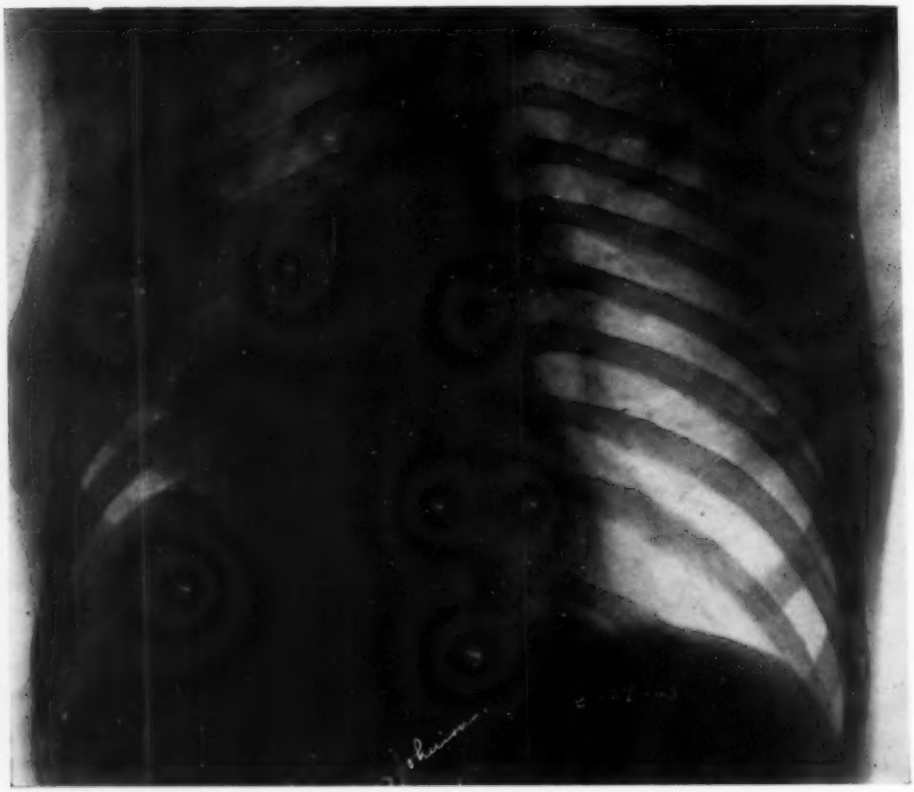

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FIG. 5.—Post-operative massive collapse of right lung. Symptoms developed 72 hours after the removal of a gangrenous perforated appendix and drainage of an abscess around the cæcum. This radiogram was taken 48 hours after onset of symptoms. Note density of shadows in the right thorax. The absence of heart shadow on the left side and the elevation and shape of the right diaphragm resulting from decreased intrathoracic pressure. Radiogram taken by Dr. Henry Thissell, Germantown Hospital.

taken without any previous illnesses or premonitions with pain in the right chest. Upon entering the hospital forty-eight hours later he had the typical symptoms of a massive collapse, which disappeared entirely at the end of six weeks. The only etiological factor which Tidy could find was the immobilization of the lower right chest and the right diaphragm. This inhibition of the respiratory muscles Tidy felt was due to the pain probably caused by a pleurisy and the inhibition or arrest of respiration was followed by a collapse of the lung. Collapse of the lung in the newborn and in infancy

has received considerable attention. Reynolds [22] speaks of airlessness in the lungs of newborn children and calls the condition apneumotosis. He was convinced at this early date, 1871, that the distribution of affected lobules was in direct relation to bronchial tubes, lobules supplied by one particular bronchial tube often presenting characteristic lesions, while lobules supplied by closely adjacent bronchial tubes may be perfectly healthy. In his mind this precluded the possibility of it resulting from an infection spreading by simple continuity. But literature contains the greatest number of references to pulmonary collapse after diphtheria as described by Pasteur.[13] The military surgeons supply the next largest group of cases in those of traumatic origin, following unilateral wounds of the chest (penetrating or non-penetrating) non-penetrating wounds of the abdominal wall and occasionally wounds of the buttocks, pelvis and thigh. There has been an increasing interest of late in its relation to operative procedures.

Varieties.—As the clinical forms of massive collapse are quite similar irrespective of the variety, it will be possible to consider the subject with reference to the varieties merely from an etiological standpoint. Thus the clinical forms irrespective of their etiology may be (1) lobular, (2) lobar, or (3) total in distribution. In the lobular or partial type the upper or middle third of one or both lower lobes is the part most frequently affected. In the lobar type one or both lower lobes are usually affected. In the total variety the whole lobe is in collapse. Massive collapse not only varies in the extent of the area involved but also in the degree of airlessness, and it is this variation in the amount of air which accounts for weak or absent breath sounds at times and at others loud tubular or amphoric breathing. The similarity of the phenomena of collapse of the lung in post-diphtheritic paralysis to that found so frequently in the misnamed post-anæsthetic pneumonia was first called attention to by Pasteur [13] in 1914, and has aroused considerable interest; the English literature contains excellent clinical and experimental observations. Rose-Bradford [23] gave the first exhaustive discussion of the phenomena which he had encountered so frequently as a result of gunshot wounds of the chest. That it was not fully recognized by him until after very extensive experience with chest cases probably means that it is really much more frequent than he found. He reports his belief that it occurs in fully 10 per cent. of all non-penetrating injuries of the thoracic wall. The most readily recognized and certainly the best for study are those cases which are associated with non-penetrating wounds of the chest wall and especially those which curiously occur on the side opposite to that injured. He did not have the opportunity of seeing patients who had wounds of other portions of the body, his work being confined to those of the chest, but as we have elsewhere stated he had knowledge of its occurrence following abdominal wounds, wounds of the pelvis, buttocks and lower extremities, but no cases with wounds of the head or upper extremities. The varieties encountered in thoracic wounds he divides into homolateral, contralateral and bilateral, all of which may be lobular, lobar or total. The contralateral variety of

massive collapse involving the whole of one lung is a very remarkable condition, more especially as in many cases the wound on the opposite side is not only non-penetrating but most trivial in character, causing no fracture nor indeed any extensive injury of the chest wall. Personal communications from a number of American, English and French medical officers in the late war has given evidence that this phenomena was frequently recognized but unexplained. In war, of course, the determination of its earliest establish-

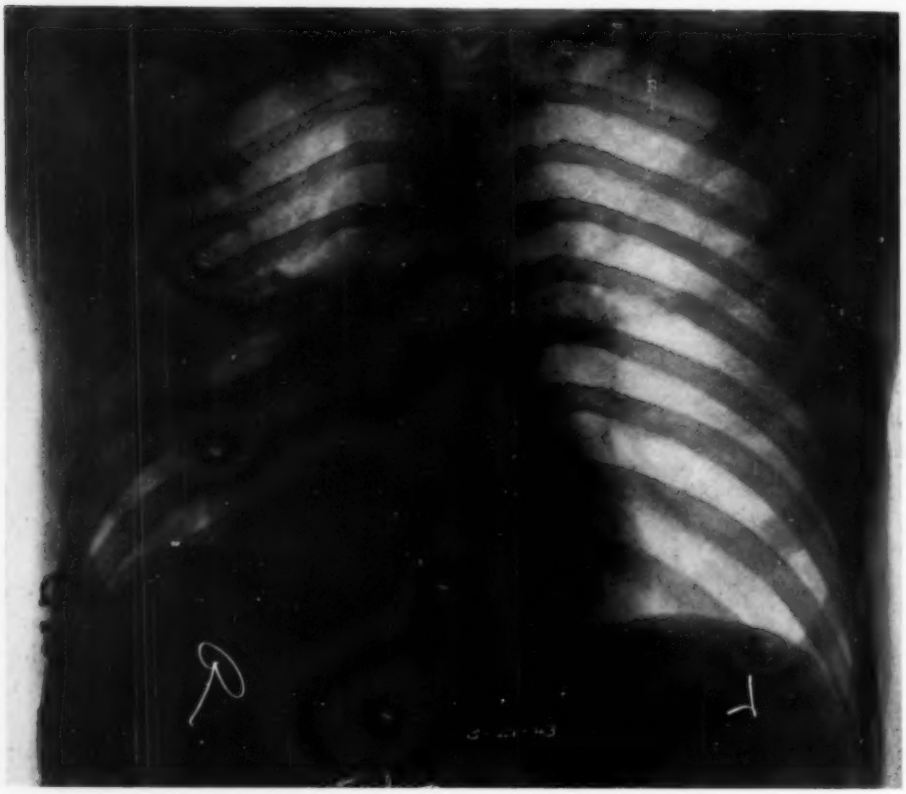

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FIG. 6.—Post-operative massive collapse of right lung. Radiogram taken 4 days after that shown in Fig. 5. Note the reinflation of the upper and lower lobes of the right lung with air. Outline of heart clearly shown with right border to right of mid-clavicular line. Right diaphragm still elevated. Radiogram taken by Dr. Henry Thissell, Germantown Hospital.

ment after the receipt of the wound was quite impossible, but Rose-Bradford reports that he saw a case that was completely established with total massive collapse of one lobe, fourteen hours after the receipt of the injury. Although all this has a definite surgical bearing, the part which is germain to the present discussion is its association with operative procedures.

Etiology.—For a condition which we have seen may develop as a congenital abnormality as in the aponeumotosis, or atelectasis of the newborn; which may develop spontaneously, apparently being caused by an acute pleurisy; which follows post-diphtheritic paralysis of the respiratory muscles;

which follows infection of the lung and of the bronchi themselves, as pneumonitis and purulent bronchitis; which follows non-penetrating traumatic injuries of the chest and of the adjacent abdominal wall, buttocks, pelvis and lower extremities, and that has an approximate incidence of about at least 6 per cent. in abdominal operations; for such a condition it would seem difficult to find a common etiological factor. This is apparently true, for in the discussion of its etiology there is at the present time no definite consensus of opinion. Various theories, of course, have been offered. That it can be caused entirely by paralysis of the diaphragm or respiratory thoracic muscles is proven by Pasteur in his post-diphtheritic phrenic paralysis. Pasteur in his article [17] quotes experiments of Martin and Hare in which lungs were found collapsed in cases of death occurring in animals as the result of section of both phrenic nerves. Briscoe,[18] experimenting with normal rabbits, divided the phrenic nerve on one side of the neck and was able to obtain varying degrees and location of pulmonary collapse following this procedure. Curiously the deflation was not limited to the same side as the paralyzed half of the diaphragm. The opposite lung was affected in almost the same area and frequently to a greater degree. He also was unable to obtain, which is rather important in view of some of the theories, any evidence of a reflex paralysis or arrest of one-half of the diaphragm as the result of intra-abdominal irritation. Of course, as he said, these conditions were all tried upon normal animals and not ill ones as in the cases of Pasteur. He reports three observations upon cases of spinal paralysis, due to injury and paresis, in which there was a complete paralysis of the cord high up. In these cases he found complete deflation of the pulmonary lobes. Schroeder and Green [24] state as the result of clinical and experimental work with animals and birds: (1) That the diaphragm is not an essential muscle of respiration. (2) That the nerve supply is practically entirely dependent upon the phrenic nerves. (3) That after section of the phrenic nerve the intercostal nerve supply is sufficient to carry on the action of the diaphragm. (4) That section of one phrenic nerve produces collapse of the lower lobe of the lung on the affected side. This, of course, was not in agreement with the work of Briscoe. (5) The destruction of one phrenic nerve in man, is not necessarily fatal. Pearson-Irvine [25] report a case of diphtheritic paralysis of the thoracic muscles (auxiliary muscles of respiration) with an overacting of the diaphragm. In this case there was a definite collapse of the upper lobe of the lung. He is perhaps the first to suggest that this collapse of the lung is not only due to lack of movement of the thoracic cage but also to some extent to a paralysis of the muscles of the bronchial tree. Lictheim [26] produced a definite collapse in the lung tributary to bronchi in which he had placed laminaria plugs. These experiments were performed with rabbits. This theory of bronchial obstruction is one which has appealed to many men. Dingley and Elliott [27] suggest that in man consequent to immobilization of the thoracic wall and diaphragm, irrespective of its cause, secretion collects in the bronchioles and even in the larger bronchi sufficient to prevent the egress

of air and leads to a gradual absorption of the aveolar air by the pulmonary circulation and ultimate collapse and airlessness of the lung tissue. We have been able to confirm this by autopsy in one of our cases, a case of a strangulated femoral hernia which was operated upon under local anæsthesia. The collapse apparently occurred on the third day following the operation. This was demonstrated by X-ray. On the fifth day he had definite signs of pneumonic consolidation (lobar) of the upper right lung and he died on the

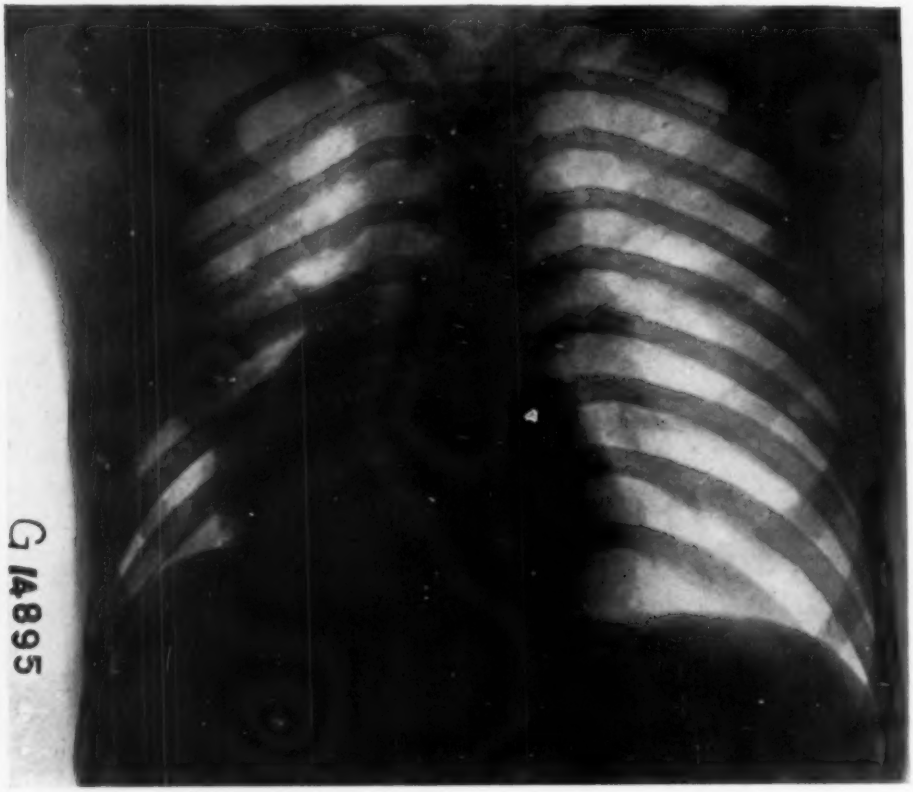

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FIG. 7.—Post-operative massive collapse of right lung. Radiogram taken 5 days after that shown in Fig. 6. Note reinflation of the right upper and lower lobes with air; middle lobe in partial collapse; diaphragm still elevated on right side. Heart in the right thorax. Radiogram taken by Dr. Henry Thissell, Germantown Hospital.

tenth day. Autopsy showed a definite collapse of the lower right lobe with a purulent pneumonia in the two upper lobes. In tracing the bronchus of the lower lobe a definite plug of purulent mucus was encountered which blocked the tissue tributary to it. Grailey and Hewitt [22] suggest the curious explanation, that the tapering funnel-like character of the bronchial tree would necessarily have an action upon the obstructing plug similar to that of a ball valve. The effect of inspiration being to propel the plug towards the alveolar tract, and jam it when it arrives at a bronchiole whose calibre is less than that which it originally occupied and during expiration it would be dislodged,

allowing the air to escape from the alveoli. Rose-Bradford is inclined to feel that obstruction does not play an important rôle. He emphasizes the fact that it is well-known that insufficient expansion of the chest, however produced, is capable of causing collapse of various degrees in the underlying lung. In some instances a constrained posture or a prolonged recumbency is sufficient to cause quite extensive collapse, involving, for instance, one lobe of the lung. Briscoe [18] agrees in part with this statement, and after his experimental work

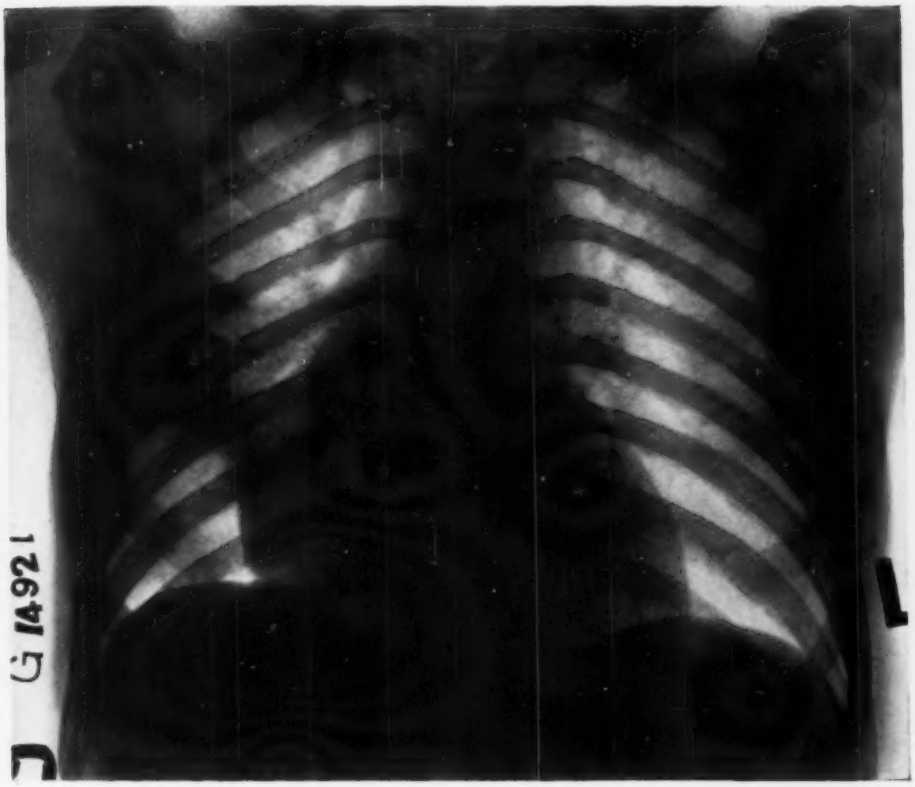

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FIG. 8.—Post-operative massive collapse of right lung. Radiogram taken 5 days after that shown in Fig. 7. Note the amount of air in upper and lower lobes of right lung is almost normal, middle lobe still in partial collapse. Heart has moved toward left. Level of right diaphragm has descended and is normal. Radiogram taken by Dr. Henry Thissell, Germantown Hospital.

with animals and more or less analytical study of posture and respiratory movements of various individuals, says that massive collapse of the lower lobes of the lung is a natural sequence of prolonged quiet breathing in the supine position in such people as do not use the abdominal muscles to fix their chest. He suggests that it is circulatory in its actual beginning, that as a result of the inhibition of the respiratory muscles an œdema of the pulmonary tissues develops following which collapse takes place. Rose-Bradford [19] also feels that in some unexplainable way this condition is brought about by reflex action, particularly when it follows injury on the opposite side of the chest,

upper abdomen and lower extremities, though, as has been stated, Briscoe was absolutely unable to demonstrate this experimentally. Cymble [28] naïvely suggests that a man with a unilateral chest wound would usually lie upon the unwounded side and the consequent immobilization of respiratory movements are the real cause in the production of contralateral collapse.

To recapitulate the explanation probably lies in more than one factor. First, to bronchial obstruction due to mucus plugs or foreign bodies or

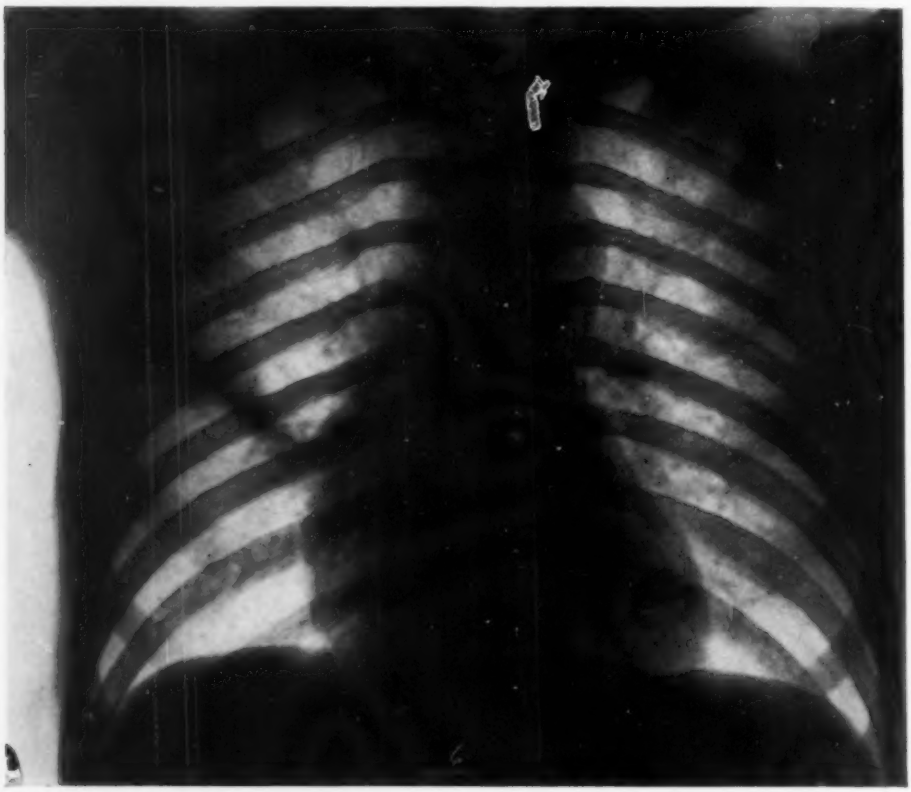

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FIG. 9.—Post-operative massive collapse of right lung. Radiogram taken 11 days after that shown in Fig. 8 and 25 days after the taking of Fig. 5. Normal air inflation in right upper and lower lobes. Middle lobe not quite normal. Heart has returned to normal position. Right side of diaphragm normal. Radiogram taken by Dr. Henry Thissell, Germantown Hospital.

possibly to some paralysis or bronchial spasm due to a reflex irritation from other parts of the body. Secondly, to arrest of the respiratory muscles either of the chest walls or of the diaphragm itself, such arrest being caused by direct nervous influence but in a large proportion of cases by posture.

Progress.—In discussing the progress of the condition, resolution usually requires from ten to twenty-one days for return to normal. The patients, at least those on record, practically never die from this condition unless it be bilateral massive collapse.

Complications.—It is the complications which produce the mortality. If

inflammation supervenes, râles may appear and a friction sound be heard over the accompanying pleuritis. Expectoration rarely appears until pneumonitis is established, and it is rarely bloody until this stage is reached. Effusion has been known to occur. When the condition occurs as a complication of bronchitis, according to Norris and Landis,[20] or bronchial pneumonia, or whooping cough, it is usually attended by a blocking of the smaller bronchi. Its presence is inferred largely by an increase in the severity of the symptoms rather than by any other sign. Purulent bronchitis undoubtedly occurs as a complication, as is evidenced in our case. Pleurisy is not uncommon as a late complication. It is usually the dry variety giving rise to a friction rub, but effusion may occur later. Pneumonia, according to Rose-Bradford, is usually limited to the collapsed lobe.

Differential diagnosis must be made from acute dilatation of the heart, pulmonary embolus, pulmonary infarct, pleuritis, with or without effusion, and pneumothorax. If one bears in mind that the affected side is retracted and immobile; that the diaphragmatic and cardiac encroachment on the affected side is extreme; that the general symptoms are invariably less severe than with pneumonia, embolism and infarction; and the marked hyperresonance and increase of breath sounds with loud transmitted spoken voice sounds, the diagnosis should be made. To this should be added the high level of the diaphragm and the question of the displaced cardiac impulse. Such errors as subphrenic collection of gas and fluid have been made to account for the upward displacement of the heart and diaphragm on the side of the collapsed lung. Pneumothorax is also a frequent mistaken diagnosis. Cardiac dilatation has been an explanation of the misplaced cardiac area. The fact that even in cases of marked cardiac displacement the pulmonary physical signs may be comparatively slight, often gives rise to a mistaken diagnosis, such as dextrocardia, but after a lapse of a few hours or days there is usually a development of the pulmonary signs and, which is more conclusive, the return of the heart to its normal position. The upward displacement of the diaphragm is a sign of the greatest importance and it is detected on the left side by physical examination and on the right by X-ray. It should also be remembered that when the entire lung or the upper lobes are collapsed the displacement of the cardiac impulse is oblique. For diagnostic purposes Rose-Bradford divides the physical signs into three periods. In the first the signs are retraction and immobility of the affected side, together with the weakness or absence of breath sounds and displacement of the heart which is often extreme. In the second weakness of the breath sounds has been replaced by loud tubular or amphoric breathing together with increased vocal fremitus, loud bronchophony, pectoriloquy and transmitted spoken voice. In the third period, the stage when the lung is expanding, abundant râles may be present over the area where the tubular breathing is marked. In both the second and third stages the heart is still displaced, but as we have previously mentioned, the lung signs may sometimes persist over a small area, at a time when the heart has returned to its normal position.

Prognosis and Mortality.—It is impossible to estimate the mortality at the present time because of the general lack of recognition of the condition. We believe we have had two fatal cases during the last six months and obtained an autopsy in one.

Our purpose in presenting this subject before such a body is to obtain the real incidence of post-operative massive pulmonary collapse. We are convinced it is far greater than Pasteur's 6 per cent., which he reported in 1914. We offer the suggestion that collapse of the lung in varying degrees always follows any operative procedure, and any traumatic or inflammatory injury of the chest and trunk which may cause inhibition of normal respiratory movement by pain or posture. We also believe that it is a constant factor in all post-operative pulmonary complications.

CONCLUSIONS

We suggest that the phenomena of pulmonary collapse of varying degrees, together with pulmonary embolism and infarction, are the real etiological factors in post-operative pulmonary complications. That all other factors, such as anæsthesia, infection (either pre- or post-operative), preëxisting lung disease, old age and debility, and the chilling of the body are contributory only.

We wish to express our obligations to the following contributors to this subject for the use of and many quotations from their writings.

Since the reading of this paper three more cases have been recognized and demonstrated by Röntgen.

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ANGINA PECTORIS AND SURGICAL CONDITIONS OF THE ABDOMEN

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The differentiation of angina pectoris from surgical conditions of the abdomen is one of the most perplexing problems, and one of the most dangerous pitfalls in diagnosis. The importance of a prompt and correct diagnosis is obvious, since surgical exploration in a patient suffering from angina pectoris is not only humiliating, but extremely hazardous.

Angina pectoris is a syndrome, not a disease, and may result from several disorders, such as obliterative disease of the coronary arteries, aortitis, syphilitic and non-syphilitic, aortic valvulitis, aneurism, adhesive pericarditis, and occasionally stenosis of the mitral orifice. The pain invariably bears a definite relationship to influences increasing the load of the heart, as exertion, eating, emotionalism, and so forth. The pain is usually of the pressure or bursting type, varying from mild discomfort to agony, originating behind the sternum and radiating into the left arm. A sense of impending dissolution, an associated sense of constriction around the chest, and areas of hyperæsthesia often attend the severe seizures. Cases in which these typical symptoms are present do not offer diagnostic difficulties, but if the origin of the pain, the distribution and relationship are bizarre, much difficulty is experienced by both surgeon and internist. The fact that angina pectoris and many of the painful surgical conditions of the abdomen manifest themselves toward middle life adds more confusion to an already perplexing situation.

A few years ago I reported a group of cases of atypical angina pectoris in which the character, origin and distribution of pain, simulated practically every known surgical condition of the abdomen. The most common bizarre symptom was the sudden severe attack of pain, usually in the mid-epigastrium, or right upper abdomen, radiating through to the back, usually precipitated by the ingestion of a heavy meal and associated with belching. I have recited the symptoms as I so frequently hear them from the patient, and certainly my first reaction to such a story is to believe that the gall-bladder is affected.

The importance of careful questioning and cross-questioning of patients in middle life should be strongly emphasized. In each case the possibility of angina pectoris must be considered. One should not rely too much on the patient's voluntary recitation of symptoms, as often important details are omitted and emphasis placed where it tends to mislead the questioner, as in the case of the patient who emphasizes the eating of a heavy meal, and does not mention the effect of exertion. Assuming that the patient is a man of sedentary habits, who in his ordinary routine does not exert himself sufficiently to increase his cardiac load to the point of pain, the eating of an unusually

heavy meal will always excite the attacks because the work required of the heart to digest this meal exceeds the threshold of his cardiac reserve.

Another syndrome less frequently attending obliterative disease of the coronaries is that characterized by the sudden attacks of paroxysmal dyspnœa usually occurring at night or in the early morning, and not associated with exertion. Patients with these symptoms rarely complain of pain. Early writers referred to the condition as angina pectoris sine dolore.

It is an interesting fact that when angina pectoris of coronary origin occurs in women, it rarely assumes the serious aspects that it does in men. The seizures are usually not so severe, they may be present for a time, then cease entirely and permanently. W. J. Mayo has repeatedly called attention to this fact. A woman does not ordinarily die in an anginal attack, although progressive heart failure often results in death. The reasons for this are not clear.

The coëxistence of angina pectoris and surgical conditions of the abdomen is not uncommon. In this connection it may be noted that in eighty-six necropsies made at the Mayo Clinic in which sclerosis of the coronary arteries was found the gall-bladder was diseased in 24 per cent. When this coëxistence occurs, the question of operation must be determined by the findings in the individual case. Certain internists, particularly the so-called cardiologists, believe that a patient suffering from angina pectoris should not be operated on. Such an attitude, I believe, is entirely unjustified, as in certain cases operation is indicated, and distinct cardiac improvement is sometimes observed following operation, particularly, if an infectious process has been eliminated. W. J. Mayo has emphasized this relationship to infectious disease of the gall-bladder and biliary passages. If malignant disease is operable, I believe that surgery is always indicated, if the patient has a fair chance of surviving the operation. The patient should be carefully and completely examined, in order to obtain as much information as possible with regard to the cardiovascular system. Röntgenographic and electrocardiographic examination should be made when possible, and more important, the patient's reaction to increased demands on the heart and circulation should be cautiously determined. Needless to say, the facts regarding risk should always be frankly discussed, either with the patient himself or with his immediate relatives.

Pathologic Processes Causing Angina Pectoris. Coronary Disease.—Many American physicians have wholly or partially accepted Allbutt's emphatic statements, denying that obliterative disease of the coronary arteries is a cause of angina pectoris. However, one accustomed to seeing many patients with angina pectoris, and correlating clinical observations with necropsy findings, is quite unable to relinquish the coronary hypothesis. It is not my intention to invite a controversy, but I believe that in a great many instances, the coronary arteries are the cause of angina pectoris.

Considerable sclerosis of the coronary arteries may be present with relatively little impairment in the cardiac circulation, the obliterative type of arterial degeneration of either the larger or the terminal vessels being the cause of trouble. The obliterative process is one of atherosclerosis, a rather irregular thickening, having a tendency to encroach on the lumen of the vessel. The factors concerned with the production of arteriosclerosis are still hypothetic, but it is reasonable to believe that infections at least tend to cause such a process to advance more rapidly, and perhaps in some cases, initiate the damage. Evidence is accumulating, favoring the concept that arteriosclerosis follows severe infections; generalized arteriosclerosis in young patients at times has been observed to follow in the wake of the severe pandemics of influenza. Similar observations were made by physicians years ago, after the severe typhoid epidemics. It is reasonable to believe that a severe constitutional infectious disease may injure the arteries and that, in the reparative process, fibrosclerosis occurs. In view of this, the removal of possible infectious foci in the hope of delaying the progress of the degenerative process seems to be indicated, provided, of course, the damage has not been so extensive that death may result in a relatively short time.

The impairment in circulation may be only so slight, that no subjective discomfort is experienced by the moderately active patient in whom there are no detectable objective cardiac changes. It is only during the period of cardiac overload that the patient is aware of trouble. Since in middle life there is a very rich anastomotic coronary circulation, especially in the left ventricle, the early obliterative changes may not cause alterations in the myocardium. A very clear idea of the coronary circulation may be obtained by studying the excellent photographs in Gross' book, which show the vascular changes as they occur through the decades.

As the obliterative changes progress, further trouble is experienced by the patient, the pain becomes more severe and the attacks occur more frequently and with less provocation. Owing to the progressive diminution in blood supply, degenerative myocardial changes occur, coincidentally with muscle weakness, and dilatation and hypertrophy. As the result of diminution of the blood supply, serious functional disturbances in the heart muscle may precede appreciable gross or histologic changes. While much is still unknown with regard to the intricate physiologic reactions of cardiac metabolism, certain processes are evident. With the progressive narrowing of the coronary arteries the rate of blood flow through these vessels is undoubtedly retarded, which tends to diminish the oxygen content, and to increase the carbon dioxide content of the venous blood. This status not only tends to favor fatigue of the heart muscle, but actually promotes degenerative changes.

There is much evidence in favor of the concept that the fundamental, characteristic property of the heart muscle, namely rhythmicality, which is an inherent quality, is the result of a physiochemic reaction which is alternately increased and diminished. With the advent of the string galvanometer, we

learned that electrical currents accompanying cardiac activity can be recorded and measured. The electropotential of the heart is probably the result of the fundamental reaction rather than its exciting agent. Quite early alterations in the physiology of the heart muscle are discerned by studying the changes in electropotential as recorded by the string galvanometer, thus much valuable information may be gained by the use of the electrocardiograph.

It is well known that patients suffering from angina pectoris of coronary origin present little or no evidence of cardiac disease. The röntgenogram is of little value in this condition as the heart is not enlarged, but often the electrocardiogram reveals changes of marked diagnostic and prognostic significance.

T-wave negativity, or inversion in certain isolated or combined derivations of the electrocardiogram, are the most important and common abnormalities. I have previously emphasized these findings, and have called attention to the high and early mortality among patients of whom these abnormalities are recorded. In order of importance T-wave negativity occurred (1) in combined Derivations I and II, (2) in Derivation I alone, (3) in combined Derivations I, II and III, and (4) in combined Derivations II and III. These findings, of course, are independent of the action of digitalis in producing T-wave negativity.

The graphic changes next in frequency and importance are the aberration of the QRS complex affecting all derivations. These changes likewise entail a high and early mortality. If the foregoing abnormalities coëxist, the mortality is very high. Clinical methods do not suggest a clue to the presence of significant T-wave negativity, and therefore, the graphic findings are valuable and important diagnostic and prognostic adjuncts. Associated with aberration of the QRS complex in all derivations, however, frequently quite definite and characteristic auscultatory changes are detectable, consisting in a lack of definition and of differentiation in the heart tones, resulting in a tic tac rhythm almost fetal in character.

The presence of these graphic abnormalities should preclude surgical intervention except in those cases in which operation is imperative, as in operable malignant disease, strangulated hernia, acute visceral perforation, acute suppurative disease of the abdomen, or trauma from intra-abdominal hemorrhage. Whenever there is evidence of a failing myocardium, and surgery is not urgent, pre-operative cardiac preparation is indicated, the detail of which is, of course, an individual problem. Usually the heart should be well under the influence of digitalis, but the drug must be administered with caution and intelligence, as occasionally a patient suffering from coronary disease is observed in whom the painful seizures are exaggerated as the result of administering digitalis. The nitrites should be available during and after operation, and in my experience the most crucial time is when the patient first begins to be up and around. A local anæsthetic is always preferable, but ether well administered is not contra-indicated when the surgeon feels

that the operation can be performed with greater facility and speed with the patient asleep.

Coronary Embolism and Thrombosis.—Many sudden deaths in middle and later life are due to sudden occlusion of the coronary circulation by embolism. An embolism of a small coronary artery is not always fatal, as in older persons there are rich anastomoses of the left ventricle. The size and location of the resulting infarct determine the seriousness of this accident. The characteristic syndrome attending coronary embolism is the extremely sudden onset of excruciating pain, usually behind the lower sternum or high in the mid-epigastrium, with variable and unreliable radiation. One of the most characteristic features of the pain is its persistence until death relieves the sufferer, or, when the infarct is small and has not involved a vital area until the heart begins to recover from the severe insult. The patient is in profound shock, with pallid cyanosis, cold perspiration, clammy extremities, rapid, shallow respirations later becoming the Cheyne-Stokes type, rapid, thready pulse, and the facies of extreme suffering. The blood-pressure is low. These symptoms are most often confused with the acute perforation of a gastric or a duodenal ulcer, the rupture of a distended gall-bladder, or acute hemorrhagic pancreatitis.

Physical examination, soon after the onset of the accident, may reveal only weak, rapid heart tones, the rhythm at times being interrupted by premature contractions and at times by respiratory arrhythmia. A few hours later a distinct pericardial rub is audible, usually to and fro in character, and heard best over the lower sternum. This rub is due to the inflammatory reaction of the visceral pericardium overlying the infarcted area. If the infarct is large, the area of cardiac dulness will be found to increase, owing to the weakening of the muscle with the development of an out-pouching or so-called cardiac aneurism. The upper abdomen may be distinctly resistant and almost rigid on palpation, falsely pointing to disease of the upper abdomen. This is in part, at least, due to the splinting of the diaphragm, a protective mechanism resulting from the patient's attempt to reduce the excruciating pain.

Leukocytosis, as high as 15,000 to 25,000 usually occurs, completely misleading to the uninitiated. Fever, often attaining from 100° to 102° may be present within twenty-four hours. The absence of pulsation in one or the other dorsalis pedis artery in cases of acute coronary obstruction is noted at times, but the reliability of this sign is doubtful. Electrocardiography is very helpful, giving a record virtually pathognomonic. The T-wave is markedly increased in amplitude and blends with the downstroke of R before its completion. In other words, there is a tendency of fusion between the R and the T-waves. Sudden high amplitude, and peaked inversions of the T-waves also occur, especially if the patient recovers, and the infarction is presumably small. Pardee and Smith have reported instances of this type in the heart in both dog and man.

The importance of prompt and correct recognition of acute coronary

obstruction is evident since exploration, for an imaginary abdominal accident would invariably result in death.

Syphilitic Aortitis.—It is not uncommon to disclose syphilitic aortitis in the course of a routine examination, although it is not often recognized early. In a recent study of 140 cases, only 7 per cent. could be classified as early. In the present study anginal seizures occurred in 36 per cent. of the cases, and in the majority the origin and radiation of pain were typical. Many of the bizarre cases closely simulated abdominal disease, and a number of the patients were referred with the diagnosis of gall-stones. There is very little difference between the character of the pain of syphilitic aortitis and the anginal pains of coronary disease, but in the former the pain tends to last longer and is very likely to radiate dorsally besides being distributed elsewhere. These slight variations are interesting, but have little quantitative value in the consideration of the individual case.

The diagnosis of syphilitic aortitis rests on an accurate history of infection and on the clinical symptoms, together with the accurate interpretation of physical findings, and the evaluation of special laboratory methods. Syphilitic aortitis is much more common in males than in females, the ratio being about 5 to 1. This, of course, is also true of syphilis in general, and supports Stokes' theory that there is an increased immunity in women against the ravages of the *Spirochæta pallidum*. Another important point in the history of syphilitic aortitis is the long period from the manifestation of the primary lesion until subjective and objective symptoms of aortic involvement become evident. In our study this latent period was nineteen and one-half years.

In a recent publication I called attention to a physical sign very helpful in the recognition of early syphilitic aortitis. In order to appreciate the probable mechanics concerned in the production of this sign, a brief review of the pathology of the disease is necessary. The arch of the aorta is most often the seat of trouble, and next in frequency, the ascending aorta and descending aorta. Klotz has shown that the *Spirochæta pallidum* gains entrance through the small lymphatics accompanying the vasa vasorum. The infectious process coming from without, first attacks the adventitia resulting in periaortitis. This explains the cohesion of the aorta to the surrounding structures, often observed at necropsy. The media and the intima then become involved, and the disease is well advanced.

Years ago Potain called attention to a peculiar tambour-like accentuation of the aortic second sound in certain patients with syphilis of the aorta. Later, Longcope and McCrae emphasized this observation, but evidently it has since been forgotten. Quite early in my experience with cardiovascular syphilis I was impressed with this unusual and distinctive aortic second tone, but did not fully appreciate its importance until the opportunity was afforded of observing a patient for several years. This patient had typical cutaneous syphilis, and was receiving rigorous treatment for syphilis at the time of the primary examination. The only finding was the peculiar tympanitic accen-

tuation of the aortic second tone. The patient was again examined nine months later and this distinctive tone was absent, but a rough reverberant systolic murmur was heard at the aortic area, which was transmitted into the carotids. At the end of eighteen months all the phenomena of a well-established aortic regurgitation were present. I have since observed this sequence of events in five other cases.

The probable mechanics of this distinctive aortic second tone is interesting and plausible in view of Klotz's work. Recalling the fact that the primary involvement of the aorta is in the adventitia, it can readily be appreciated that the resulting periaortitis tends to diminish the elasticity or resilience of the aortic wall. The inrush of blood from the heart with a competent aortic valve causes a sudden and sharp closure resulting in the phenomenon described. A rather rough reverberant systolic murmur at the aortic area, often transmitted into the carotids, is probably indicative of intimal involvement, and is evidence of a moderately advanced aortic syphilis. With the appearance of the systolic murmur, the tympanic second tone usually disappears, and at this stage there is usually a variable degree of hypertrophy of the left ventricle.

The syphilitic process is retrogressive as well as progressive and eventually the aortic valve leaflets or ring become involved with the development of aortic regurgitation. The signs of aortic regurgitation are too well known to need comment; it is an indication of advanced aortic syphilis. The syphilitic process is associated with a marked tendency to reparative fibrosis which is responsible for much of the progressive myocardial damage. Fibrotic changes of the aorta in the vicinity of the coronary orifices may advance until there is almost complete closure of the orifices. The effect on the heart, as the result of the narrowing of the orifices, is identical with that of obliterative disease of the coronaries themselves. The patients almost always have severe anginal attacks or seizures of paroxysmal dyspnœa. Usually the heart is considerably dilated, particularly the left ventricle, and out of proportion to the attendant hypertrophy.

In many cases the electrocardiographic findings are identical with those frequently observed in cases of obliterative coronary disease, that is, significant T-wave negativity and aberration of the QRS complex in all derivations. In the early and the moderately advanced stages of aortic syphilis the graphic records reveal very little of importance.

Non-syphilitic Aortitis.—The most common non-syphilitic affection of the aorta is atherosclerosis. It is, in reality, a degenerative rather than a true inflammatory process, occurring in the course of the progressive, more or less generalized arteriosclerosis of advancing years, but at times is dominantly manifested. It is a frequent accompaniment of the arterial degeneration of the cardiovascular-renal syndrome with hypertension. Next in frequency is the aortitis due to rheumatic fever, practically always associated with, and often secondary to, endocarditis of the aortic valves. Typhoid fever, influenza and many of the exanthematous fevers have been ascribed as causes

of aortitis, but they probably are rather infrequent causes. Anginal attacks occur much less frequently with the non-syphilitic forms of aortitis. The usual physical sign of the disorder is a systolic aortic murmur having a greater range of transmission, being at times distinctly audible well over the lower sternum. It is, as a rule, more prolonged than the murmur in cases of syphilitic aortitis, and is harsh, but does not possess the reverberant character of the former. The aortic second tone is usually accentuated except when the aortic valves are incompetent. When hypertension is present, the aortic second tone is very distinctly accentuated, and often has a distinctly metallic quality. The heart is enlarged, and hypertrophy of the left ventricle dominates until failure results, when dilatation progresses disproportionately. Significant T-wave negativity is often revealed by electrocardiographic examination.

Aneurism.—Syphilis is the cause of aneurism in most instances. The condition is often associated with angina pectoris. The thoracic aorta is usually the seat of aneurism, the arch and ascending portion most often, and the descending portion least often. The pain of aneurism usually is like that in the typical descriptions of angina pectoris, except that it usually is boring in character, tends to be more persistent, is likely to occur independent of cardiovascular overload, and often the dominant radiation is dorsal.

The physical signs of thoracic aneurism are too well known to enumerate them here. There is no excuse to fail to recognize an aneurism after careful examination except when it has very unusual features. I distinctly recall a case of large aneurism of the descending aorta that simulated, both in physical signs and in the röntgenogram, a large effusion of the left chest.

Aneurism of the abdominal aorta is rare; it produces pain often simulating that in surgical conditions of the abdomen. The aneurism almost always occurs in the immediate vicinity of the celiac axis. Aneurism of the abdominal aorta is usually mycotic, the result of a weakening of the wall at a point of bifurcation, due to pyæmic embolism. Syphilis is the next most common etiologic factor, while trauma plays a lesser rôle. Besides having pain, the patient is made uncomfortable by the epigastric pulsations, which often overshadow the pain. The aneurisms are usually fusiform or diffuse; saccular dilatations of the abdominal aorta are less common. Early recognition of abdominal aneurism is difficult and uncertain, and diagnosis is not possible until the pulsating tumor is palpable in the epigastrium. A distinct systolic bruit or thud is often audible over the tumor. Not infrequently the pulsations of the abdominal aorta of an undernourished, nervous patient, or the increased pulsations of the aorta of a patient with hyperthyroidism, are mistaken for aneurism although there is no occasion for this error. The X-ray does not aid in the recognition of abdominal aneurism. It is needless to say that operative intervention, if the aneurism is large, is contra-indicated unless absolutely urgent.

Adhesive Pericarditis.—Adhesive pericarditis, particularly if there is

cohesion of the pericardium near the base of the heart with the mediastinal structures, is often the cause of anginal pain usually in the chest, but occasionally it is entirely in the upper abdomen. The pain may bear a definite relationship to cardiac overload. Adhesive pericarditis results from inflammatory thoracic disease, such as left-sided pneumonia, pleuritis, mediastinitis, empyema and so forth. Primary extensive fibrinous or suppurative pericarditis, besides causing adhesions between the two layers of the pericardium, may cause the sac to be bound to the mediastinal structures, or to the pleura. Influenza has been a relatively common cause of mediastinopericarditis. The diagnosis of the condition, as a rule, is not difficult. It should be borne in mind constantly during routine examination of the chest, which usually reveals the salient diagnostic signs. A careful scrutiny of the apex beat discloses a definite retraction of the intercostal structures during each systole of the heart. There are usually similar retractions posteriorly in the ninth to the twelfth intercostal spaces, the so-called sign of Broadbent. In marked cases the whole lower left thorax will be seen to be drawn in with each cardiac systole. The heart dulness is practically always increased, varying with the degree of associated myocardial disease. Over the lower sternum, and at times over the middle and upper sternum, a distinct pericardial rub is audible. With the patient leaning forward I have repeatedly observed a rub which otherwise was undetectable.

The false retractions of an enormously dilated heart must not be confused with the retractions of an adherent pericardium.

Mitral Stenosis.—Chronic endocarditis of the mitral valve with stenosis produces anginal attacks so infrequently that only its mention is warranted. In the cases I have observed the pain was limited to the chest.

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NON-CALCULOUS INTERMITTENT BILIARY OBSTRUCTION FOLLOWING CHOLECYSTECTOMY

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Removal of the gall-bladder on the basis of the symptoms and clinical history in the absence of a local lesion, invites discredit on the judgment of the surgeon and the operation. Sad experience has shown that gastro-enterostomy does not relieve symptoms of peptic ulcer if there is no ulcer. On the other hand, an attempt to remove the gall-bladder from a very sick patient, if severe infection, deep jaundice or other well-recognized contra-indications exist is hazardous, and the risk unnecessary. Under these conditions, a palliative drainage operation with minimal interference is the procedure of choice. Cholecystostomy will continue to hold a prominent place in biliary surgery and will cure many patients, but cholecystectomy, when it can be safely performed, will do the most good to the greatest number. The diagnosis of cholecystitis in the absence of stones is often difficult, even when the gall-bladder is visible. The presence of adhesions and enlarged regional lymph-glands, and the appearance of the liver will often help confirm an otherwise doubtful diagnosis. It is generally believed that the gall-bladder has a function, and should not be needlessly sacrificed, even though an individual can live comfortably without it. The diseased gall-bladder loses its function, which with the fact that more than 50 per cent. of the patients whose gall-bladders have been drained have had recurrence of symptoms requiring a second operation, seems to indicate that the best procedure is removal of the organ in the presence of local disease. Granted that removal of the gall-bladder is justified, the surgeon will still be called on to treat a small group of patients with persistent or recurrent symptoms. A definite percentage of these will have stones in the common duct which probably were present at the time of the former operation.

The mimicry of upper abdominal diseases by an inflamed appendix, and its frequent association with infection in the gall-bladder, make its removal almost a routine procedure in operations on the biliary passages. Injury to the ducts at operation, if not recognized and repaired at once, will surely demand later interference of a very formidable nature. Of forty-seven cases of stricture of the common duct which we recently reviewed, more than half were located at the juncture of the cystic duct where the gall-bladder had been removed, and may have been the result of injury. Careful technic and thorough exposure should prevent such injury.

We believe that the most potent cause of persistence of symptoms after cholecystectomy is delay of the patient in coming to operation. Patients are often seen who have had definite symptoms of biliary disease for ten or fifteen years, many having suffered irreparable damage to the liver and pancreas. It is misguided optimism, however, to expect that removal of the gall-bladder, although diseased and full of stones, will always relieve such patients of their symptoms.

It is becoming more generally recognized, chiefly through the work of Graham, that the liver, pancreas and appendix are commonly infected with the gall-bladder. Persistence of infection in these organs is often a cause for recurrence of symptoms after cholecystectomy. Such symptoms may continue for several months after operation and then disappear, but in a certain number ultimate cure does not result, and at the second operation the meagre findings do not explain the patient's symptoms. Having seen a number of such patients relieved by drainage of the common duct, we selected from the records of the Mayo Clinic for detailed study a series of twenty-four cases from a large number in which secondary operations had been performed on the biliary tract. No cases of stones in the ducts, stricture, biliary fistula, or other gross lesions, were selected.

Seven of the twenty-four patients were men and seventeen women. The youngest was twenty years and the oldest sixty-nine, the average age being forty-five years.

Symptoms Occurring Before the Primary Operation on the Gall-bladder.—The longest duration of symptoms was fifteen years and the shortest, three months, the average being forty-three and one-half months. Typically severe hepatic colic was associated in twenty-two cases, jaundice in ten, fever in four, upper abdominal pain not colicky in one, and reflex gastric symptoms in one. The foregoing symptoms correspond with the history usually elicited from patients suffering from disease of the gall-bladder. Attention is directed to the fact that the average duration of symptoms was more than three and one-half years. Probably no other obviously surgical condition is allowed to progress so long.

Primary Operation.—The primary operation was performed in the Clinic in nine cases, and elsewhere in fifteen. Detailed information was available regarding the lesions in the nine cases, while in the group of fifteen, data were obtained from patients, based on the information given them by their surgeons. In several instances the patients had letters describing the findings at the original operation.

The gall-bladder was diseased in every case; in fifteen it contained stones, and in nine there was cholecystitis without stones. Stones were found in the common duct in two cases. Pancreatitis was noted in four, and appendicitis in eight. These lesions represent about the usual findings in a group of cases of gall-bladder disease. Primary cholecystectomy was performed in nineteen cases, the appendix was removed in sixteen, at the time of the opera-

tion on the gall-bladder in eight, and at some time preceding the operation on the gall-bladder in eight. Cholecystostomy followed by cholecystectomy was performed in five cases. The common duct was opened and a stone removed in one of these.

Symptoms after Cholecystectomy.—The time of onset of the post-operative symptoms varied from a few weeks to four and one-half years. Recently we saw a patient, not included in this series, who had a recurrence of symptoms seven years after cholecystectomy, but at the second operation there was little evidence of disease. In nine cases the symptoms appeared during convalescence and continued intermittently until the second operation. In the remaining fifteen the average time of onset was two months after operation. Severe colicky pain occurring in attacks similar to those preceding the original operation was the cardinal symptom in all cases, and was the chief reason for seeking relief by a second operation. Two patients had chills and fever with the attacks, thirteen had jaundice following the attacks of colic, six of whom noted clay-colored stools. We believe these symptoms were caused primarily by temporary biliary obstruction, although only slightly more than 50 per cent. of the patients had jaundice. It has been shown experimentally in the dog that the common duct must be completely obstructed for at least twelve hours in order to cause jaundice. It is probable that there may be blockage of the common duct in man, long enough to cause the severe pain of sudden obstruction, which may be relieved before jaundice has had time to develop. The duration of symptoms before the second operation varied from three weeks to seven years, the average being twelve and seven-tenths months.

When these patients were examined in the Clinic, the symptoms and clinical history seemed to warrant the diagnosis of stone in the common duct. The majority of patients who have severe colic following cholecystectomy, with associated chills, fever, and intermittent jaundice, will be found to be suffering from stone in the common duct. In twenty-three of our twenty-four patients such a diagnosis was made. Pancreatitis was diagnosed in one case; one patient had evidence of biliary cirrhosis.

Second Operation.—The common duct was opened and explored. In twenty-two cases a Robson drain was inserted into the common duct. In two cases the duct was closed tightly by suture after the exploration, but there was drainage of bile for several weeks. The appendix was removed in five cases. The stump of the cystic duct was excised in two. In cases in which the common duct was drained the bile continued to discharge through the tube or fistulous tract for from three to four weeks. One patient died in the hospital from hemorrhage, cholangitis and biliary cirrhosis.

Findings at Second Operation.—The most constant lesion was pancreatitis, not the hard interstitial type, but resembling that termed by Deaver, pancreatic lymphangitis; it was present in seventeen cases. The degree of involvement of the gland was one in four cases, two in seven cases, three in

five cases, and four in one case. The changes in the pancreas were determined by palpation, and in a few instances by inspection of the gland. It is fully appreciated that this method of diagnosis is subject to considerable error, because of the personal equation of the surgeon. Nevertheless it is recognized that advanced pancreatitis, and the type of gland resembling malignancy can always be detected by the experienced surgeon. In none of these cases was the pancreas sufficiently affected to suggest malignant disease. Regardless of the degree of involvement there was no biliary obstruction at the time of the operation, nor was there any form of intraductal obstruction, such as stone, because in every case the common duct was opened, and probes and scopes were passed freely into the duodenum. Evidence of cholangitis was present in three cases, and of hepatitis in most of the cases. Enlargement of the regional lymph-glands was found in two cases. The liver was definitely enlarged in three cases and the spleen in two. The common duct was dilated beyond normal size in all. In two cases there was a small granulating mass in the stump of the cystic duct. A diseased appendix was found in five cases. Adhesions of the usual kind following operations on the gall-bladder were present in eighteen cases, but they were not causing obstruction of the ducts and were not considered responsible for any of the major symptoms. Two negative explorations were performed; that is, no actual lesions were found, although drainage of the common duct was established for empiric reasons.

Questionnaires were sent to all patients in an endeavor to learn their present state of health and whether they had had a return of symptoms. We were able to obtain information concerning the ultimate result in twenty-two of the twenty-four cases. Three patients are dead. One died from unknown causes after leaving the hospital, and one died two years after operation from "general collapse," but had been completely relieved of the symptoms for which the operation was performed. Three patients still complain of their former symptoms; one has biliary cirrhosis, one has severe attacks of pain associated with clay-colored stools, and the other, while still having pain and discomfort in the epigastrium, does not have the severe colics that he had before operation. Sixteen patients have been entirely relieved of their symptoms. Most of them obtained relief in from four to six weeks after operation. One continued to have symptoms for one year and another for four years, but both are now in good health.

Discussion.—We believe that these results justify the course of surgical treatment which was carried out in this group of patients. As usual, empiricism has led the way and it remains for theory and experimentation to establish the correct explanation.

There seems to be little doubt that intermittent biliary obstruction was the main cause of symptoms. Stone in the common duct was suspected, but not found at operation. Of course, a stone may have passed, but there was no evidence of it, and the common duct was normal except for dilatation, and it contained normal bile. There was no other form of intraductal obstruction

as in every instance the ducts were carefully explored and found to be free. We believe that the explanation lies in the persistence or recurrence of infection in the liver and pancreas, and in a few instances, in the appendix. The theory of infection is further borne out by the fact that the majority of patients were relieved by prolonged drainage of bile to the outside. A considerable number of patients with cholecystitis have involvement of the pancreas, and usually the pancreatitis will subside following removal of the gall-bladder.

It is well known that disease of the pancreas such as cancer of the pancreas, and the hard interstitial type of pancreatitis, can give rise to obstruction of the common duct and jaundice. It represents more or less permanent biliary obstruction, characterized by jaundice, slow and painless in onset, but constant and progressive. It is not generally recognized that the pancreas can be responsible for intermittent biliary obstruction, but we believe that the cases herein reported are examples of this condition. A number of years ago, Morison called attention to the analogy between the biliary and urinary systems. Gradual obstruction results in painless dilatation of the proximal ducts, while sudden complete obstruction causes rapid distention and pain. In this analogy, the pancreas, from a mechanical and anatomic standpoint, may be likened to the prostate. Intermittent obstruction at the outlet of the bladder can be caused by infection in the prostate, while obstruction, more or less permanent in character, results from hypertrophy or malignancy. The swollen, œdematous gland of pancreatic lymphangitis, the type associated with cholecystitis, might in a similar manner, cause intermittent biliary obstruction, colic, and even jaundice. The normal gall-bladder functions as a tension bulb in the presence of common duct obstruction as in cases of carcinoma of the pancreas. After removal of the gall-bladder any sudden obstruction to the common duct causes rapid distention of the proximal ducts with resulting pain. If the elasticity of the gall-bladder has been destroyed by disease, or if it has been removed, pancreatitis may be the cause of biliary obstruction, severe colic and jaundice. This is probably the explanation of events in some cases of cholecystitis without stones, in which severe colic and jaundice have occurred.

After reviewing the histories of these patients, we are convinced that an accurate diagnosis cannot always be made. The symptoms are those of intermittent biliary obstruction, the usual cause of which is stone in the common duct. The surgeon should not be disappointed if he occasionally fails to find a stone. Drainage of the ducts will relieve the symptoms in most cases.

ACUTE APPENDICITIS IN CHILDHOOD

A STUDY OF 145 CASES OBSERVED AT BELLEVUE HOSPITAL OF NEW YORK CITY

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The 145 cases of acute appendicitis analyzed in this paper constitute a series of consecutive cases operated upon on the Children's Surgical Service of the Fourth Surgical Division, Bellevue Hospital. They include children of ages up to thirteen years. These patients were treated in the hospital from December, 1919, to January, 1923, inclusive, a period a little longer than three years. After discharge from the hospital they were kept in touch with by means of our "Return Clinic." We have been able in this way to see personally the late results of 126 out of 134 of our living cases, a percentage of 94.02. In addition, one case was seen by our social worker and one we heard from by letter; six we were unable to trace.

In all statistics of final results our figures are based entirely upon the 126 cases which we have been able to see personally. On none was the final examination made at a period less than six months after discharge from the hospital, and in some the period between discharge from the hospital and final examination was as long as three years.

To include a case as one of acute appendicitis, the records had to state definitely that there were gross pathological lesions of acute inflammation present.

The procedure as carried out in these cases was as follows: As soon as a diagnosis was made the patient was operated upon; the usual incision being the right rectus, with separation of the muscle fibres. In all there were 113 cases in which this incision was used, the McBurney gridiron incision being employed only thirty-two times. An analysis of incidence of incisional hernia in relation to these two types of incision could not be made, as the McBurney incision was seldom used in the more severe cases. The reason for using the right rectus incision so often in children is that we feel it gives a very much better exposure, permits easier exploration, and is more flexible for adaption to new conditions when a mistake has been made in diagnosis. The McBurney is most useful where it is known that there is an abscess immediately below the position of the incision. The appendix was removed by means of the cautery, the stump being inverted into the cæcum by means of a purse-string stitch of linen thread and reinforced with a few peritoneal stitches of number 0 chromic. In a few cases the appendix was merely ligated, as the cæcal wall was too indurated to allow inversion.

Drainage of the peritoneal cavity was used in all cases in which the appendix had perforated and also in those in which marked induration of the tissues surrounding the appendix was present. In abscess cases, a single

drain in the cavity was usually sufficient, but in the cases of spreading peritonitis a drain was usually placed in the pelvis as well as in the right lumbar gutter. The ordinary cigarette drain—a wick of gauze surrounded by rubber dam—was used, the abdominal wall being closed in layers about it. Following operation, fluids were pushed usually by means of enteroclysis (tap water with 5 per cent. glucose and 5 per cent. soda bicarb) or in the very sick hypodermoclysis was resorted to. No post-operative catharsis was used, for we found that enemas were quite sufficient to control distention; in the more severe cases we have used stupes.

Blood transfusion by the whole blood method was found to be very beneficial in the long-drawn out cases of sepsis.

The cases have been classified into three groups: Those that had not perforated; those that had perforated and in which there was free purulent exudate in the peritoneal cavity, a spreading peritonitis; and those of perforation in which the exudate had been localized by adhesions and formed an abscess.

The incidence of acute appendicitis among children is of interest from the standpoint of age: in the first 5 years of life we had 17 cases, or 11.7 per cent. of our series; from the 5th year to the 13th there were 128 cases, a percentage of 88.3; the greatest number of cases, 30, or 20.7 per cent. of the whole, were found to be of the age of 11; our youngest case was 20 months; the average age was 9 years; the number of cases for each age increased up to 11, where it seemed to reach its maximum. This is shown very well in the accompanying table:

TABLE I.

Age	Male	Female	Total	% of series
1	1	0	1	.7
2	4	1	5	3.5
3	2	2	4	2.8
4	4	3	7	4.8
5	3	1	4	2.8
6	7	6	13	8.9
7	6	4	10	6.8
8	10	8	18	12.4
9	13	6	19	13.2
10	14	6	20	13.9
11	19	11	30	20.6
12	8	6	14	9.6
Total.....	91	54	145	100

There was a very decided difference in the two sexes; 91 males (62.8 per cent.) compared with 54 females.

In our 145 cases we had 11 deaths, a mortality of 7.58 per cent. The accompanying table shows the age and immediate cause of death:

TABLE II.

Age	Sex	Time sick before operation	Additional diagnosis	Time between operation and death	Apparent cause of death
20 mos.	M.	3 days	Spreading peritonitis	Less than 24 hours	Toxæmia.
2 yrs.	F.	4 days	Spreading peritonitis	Died on table	Toxæmia.
2½ yrs.	M.	3 days	Spreading peritonitis	Less than 24 hours	Toxæmia.
2½ yrs.	M.	6 days	Abscess	27 days	Fecal fistula. Secondary abscesses.
2½ yrs.	M.	2 days	Spreading peritonitis	Immediately after operation	Toxæmia.
3 yrs.	F.	3 days	Abscess	3 hrs. after operation suddenly	Status lymphaticus (autopsy).
5 yrs.	F.	2 days	Spreading peritonitis	Less than 48 hours	Toxæmia.
9 yrs.	M.	12 days	Abscess retrocæcal	Less than 24 hours	Shock.
10 yrs.	F.	2 days	Spreading peritonitis	7 days	Sepsis (convulsions).
10½ yrs.	F.	2 days	Spreading peritonitis	Less than 24 hours	Toxæmia.
11 yrs.	F.	3 days	Spreading peritonitis	Less than 48 hours	Toxæmia.

5 males, 6 females.
8 deaths from spreading peritonitis 72 per cent.
Average age at death 5.3 years.
Time sick before operation 3.4 days.

In the first five years of life there were 17 cases with 6 deaths, a mortality of 35 per cent. In the second half of this decade (that is from the 5th through the 10th year) there were 64 cases with two deaths, a mortality of 3.1 per cent. The mortality for the first decade (from birth to 10 years) was 9.8 per cent. From the beginning of the 5th to the 13th year there were 128 cases with 5 deaths, a mortality of 3.9 per cent. It is to be noted that the highest mortality was in children under 5 years of age. The mortality rate of the girls was just twice that of the boys (female 11.1 per cent., male 5.5 per cent.).

Eight deaths occurred in patients with spreading peritonitis and 3 with abscesses. There was no mortality among the cases in which perforation

had not taken place. The average age of children who died was 5.3 years; the average time sick before operation was 3.4 days.

There were 44 cases of spreading peritonitis and 53 with abscesses, leaving 48 in which the appendix had not perforated; and of these 48 cases 40 were not drained. Thus the appendix had perforated in 97 patients, 67 per cent., or two-thirds of the admissions. All cases (21) under the age of 6 years had perforated, 14 having spreading peritonitis and 7 abscesses. After this age there was no appreciable difference from year to year. The mortality for perforated cases was 11.3 per cent.

TABLE III.

Time Between Onset of Symptoms and Operation.

		No. of cases		Per cent.		No. of days preceding operation	
Unperforated	Not drained	40	48	27.6	33.1	1.7	1.7
	Drained	8		5.6		1.9	
Perforated	Spreading peritonitis	44	97	30.4	66.9	2.5	3.6
	Abscess	53		36.4		4.5	
Total cases		145		100		3	

Spreading Peritonitis.—Of the cases with spreading peritonitis the period between onset of the disease and operation was an average of 2.5 days. The longest was 8 days, but this was apparently a case in which an abscess had ruptured; the shortest period was 14 hours. Of the peritonitis cases 8 died, 18.2 per cent., and these patients accounted for 72 per cent. of all deaths. There were 11 cases whose convalescence was complicated; 2 had pneumonia, 7 had secondary abscesses, in one the wound burst open on the 8th day, and one had chronic sepsis, it being the only death among these cases with complications. Of the remaining 7 deaths, 1 died on the table, 4 died a few hours after operation, and 2 lived for at least 48 hours after operation, death in three being due to toxæmia.

Abscesses.—Of the 53 cases with perforation and abscess formation the operation was performed on an average of 4.5 days after the onset of the disease, the longest time being two weeks and the shortest 36 hours. The remainder of the total deaths, three in all, had abscess (5.7 per cent. mortality for the group). One of the cases died of status lymphaticus a few hours after operation; the second died apparently from shock; and the third died from sepsis at the end of 4 weeks. In one case the patient had been operated upon two years previously at another hospital for an appendicular abscess, but the appendix had not been removed; and in another we did not remove the appendix, as it was too adherent to the wall of an abscess. There were 2 cases of post-operative pneumonia, one being complicated with a

suppurative pleurisy and facial erysipelas. There were 7 cases which had secondary abscesses, of which 2 developed fecal fistulas; another with multiple abscess developed empyema.

Unperforated Cases.—There were 8 cases in which no perforation of the appendix occurred, though the abdomen was drained. In this group the average period between onset of the symptoms and operation was 1.9 days; there were no deaths. One case developed multiple secondary abscesses, and another an osteomyelitis of the right femur.

There were 40 cases in which the peritoneal cavity was not drained, in one of which the abdominal wall was drained. The average period before operation in these was 1.7 days. There were no deaths nor complications except for two infections of the abdominal wall.

Complications.—There were 15 cases which had secondary abscesses, 10.3 per cent. Of these 11 were located between coils of intestines, 1 was subdiaphragmatic and 3 were in the region of the right kidney. One of the cases, which had an abscess in the kidney region, also had a pelvic abscess; 7 of these abscesses followed spreading peritonitis; 7 followed perforation of the appendix with abscess, and 1 developed in a case which had not perforated but was drained. The subdiaphragmatic abscess followed a retrocæcal appendix with abscess.

Infection of Abdominal Wall.—Two cases had infections of the abdominal wall, both of which had been closed without drainage.

Post-operative Pneumonia.—There were 4 cases (2.7 per cent.) which developed pneumonia after operation, 2 of the right lung and 2 of the left.

Empyema.—Of the 2 cases (1.4 per cent.) of empyema, both upon the right side, one followed a post-operative pneumonia and the other was an extension from a subdiaphragmatic abscess.

Fecal Fistulas.—There were 2 cases (1.4 per cent.) of fecal fistulas, both in cases complicated with abscesses. One of these died upon the 28th day after operation.

In addition there was 1 case of facial erysipelas, following a post-operative pneumonia, and a case which developed an osteomyelitis of the upper end of the right femur about four months after discharge from the hospital; that this had anything to do with his appendicitis is doubtful.

Hernia.—There were 16 cases of incisional hernia, a percentage of 12.7 for all and 18 for those that were drained. In addition there were 3 recent cases in which the note on the chart showed that there was relaxation of the muscles but no real sac. These are not included among the hernias, as 8 other cases, with relaxed musculature noted some three or four months after discharge, later developed a strong abdominal wall without further treatment. There was no difference in predisposition to hernia in either sex. Incidence to age showed a gradual decrease in the frequency of this sequelæ as age advanced:

TABLE IV.

Relation of Age to Occurrence of Incisional Hernia.

Age	No. of cases followed in series	No. of hernias	Percentage
2	1	0	0
3	3	0	0
4	5	0	0
5	2	2	100
6	12	1	8.3
7	9	4	44.4
8	18	2	11.1
9	16	3	18.9
10	18	2	11.1
11	29	2	6.8
12	13	0	0
Total.....	126	16	12.7

Eleven of the hernias have since been operated upon and apparently cured. All hernias developed in cases that had been drained; 8 followed spreading peritonitis, 7 abscesses, and 1 was a sequel to operation upon an unperforated appendix that was drained.

A special study was made of the records of these cases.

Of the 16 cases, which developed hernia, in 12, portions of the abdominal wall about the wound sloughed to a greater or lesser extent. In 6, secondary abscesses developed which had to be drained, either through the original wound or through a counter incision. In 3, the edges of the wound separated. In 1, a fecal fistula developed; and in 2 cases, there was an actual prolapse of a coil of intestines through the wound. Additional causes were severe distention with continuous vomiting in 6 cases; and in all there was more or less loss of muscular tone, because of their long drawn-out convalescence, the temperature being raised on an average of 20 days for all cases.

In Case 80 no reason could be found for the later development of hernia, but as this patient had a rise of temperature for 15 days following the operation there must have been some condition present which was not recorded. Where the hernia was small, its location was in the portion of the scar through which the drain had passed. The average stay in the hospital of these cases which later developed hernias was 34.7 days.

The accompanying table tabulates the possible cause of hernia amongst these cases:

TABLE V.

Case No.	Sloughing of abdominal wall about wound	Secondary abscess	Separation of wound edges	Fecal fistula	Evisceration of loop of intestines	Distention and straining	No apparent cause
19	+	+				+	
21	+					+	
23	+						
33	+						
40	+	+					
46		+					
63	+	+	+	+	+		
80							+
85	+						
90	+						
93	+	+				+	
95	+					+	
114			+				
129	+	+					
133	+					+	
139			+		+	+	

There were 6 cases which developed large keloids in their scars; 4 of these had been drained and the remaining two healed by primary union.

Symptomatology.—The onset of the symptoms was usually sudden, with severe general colicky pain, which later became localized and constant. Vomiting was an almost invariable symptom: where it had not taken place early in the disease, we found that it almost always followed the giving of a cathartic, which was so often prescribed before the patient was admitted. Of the non-perforating cases 41, or 85 per cent., had vomiting as a symptom, and 2 of the remaining 7 were nauseated; of the 44 cases of spreading peritonitis 43, or 97.7 per cent. vomited, the remaining patients being nauseated, and of the cases complicated with abscess 44, or 83 per cent., vomited, 2 of the remaining 9 being nauseated.

The temperature was always raised, the elevation apparently depending upon the amount of tissue involved by the inflammation. In the cases that had not perforated the mean temperature was 101.3°, the highest temperature recorded in this group being 104° and the lowest 99°. There were 8 cases in this group of 48 with a temperature between 99° and 100°. In the spreading peritonitis group, the mean temperature was 102.1° and the two extremes were 105° and 99°, the latter being the only one under 100°. In the abscess cases the mean was 101.5°, the maximum 104° and the minimum

99.6°. There were only two cases with temperature under 100° among the abscess cases.

TABLE VI.

Temperature, Pulse and Respiration.

Diagnosis	Mean temperature	Mean pulse	Mean respiration	Relation of respiration to pulse rate
Unperforated cases.....	101.3	113	25	4.5
Spreading peritonitis...	102.1	127	32	4.
Abscess.....	101.5	116	28	4.1

The pulse and respiratory rates were increased in almost all cases. They were lowest in the unperforated cases, the mean being, pulse 113, respiration 25, and highest in the spreading peritonitis group, pulse 127, respiration 32, while the abscess cases had a mean pulse rate of 116 and respiratory rate of 32. The ratio of respiratory rate to pulse was in inverse order to the above, spreading peritonitis 4, abscess 4.1 and unperforated 4.5.

The 48 cases in which the appendix had not perforated, all except 6 had well-localized tenderness but no rigidity; and in only 1 was the tenderness and rigidity general. In the cases complicated with spreading peritonitis, tenderness and rigidity were general over the abdomen, except in 10 cases where these signs were confined to the right side. In the cases accompanied by abscesses the signs were localized over the site of the disease in all but 9 cases; of these latter, the tenderness and rigidity was general in 8 and in 1 case there was no rigidity. It was stated in the histories that a mass was felt by abdominal palpation; in 18 (34 per cent.) cases of abscesses and 2 (4.5 per cent.) of spreading peritonitis; where rectal masses were felt, 1 was in a case of spreading peritonitis and 3 had abscesses.

TABLE VII.

Abdominal Signs.

Diagnosis	No. of cases	Tenderness		Rigidity		Mass present	
		Local	General	Local	General	Abdominal	Rectal
Unperforated cases....	48	47	1	43	1	0	0
Spreading peritonitis..	44	10	34	9	35	2	1
Abscess.....	53	45	8	44	8	18	3
All cases.....	145	102	43	96	44	20	4

The leucocyte and differential counts were variable, high counts (30,000) and high percentages of polymorphonuclear leucocytes (94 per cent.) were found in cases of all three groups. There were no normal counts. It can be said that both counts appeared to rise proportionally in the following order: cases that had not perforated, those with spreading peritonitis and those with abscess.

TABLE VIII.
Leukocyte and Differential Counts.

Diagnosis	Mean count	Mean per cent. of polymorph. count
Unperforated cases	17,400	84
Spreading peritonitis	18,900	85
Abscess	20,700	86

From a prognostic or diagnostic standpoint no deductions could be drawn.

Diagnosis.—It is unfortunate that our records do not show accurately the number of mistakes that were made in diagnosis; however, we do known that during the period that this series covers, six cases of pneumonia were operated upon for acute appendicitis, 5 lobar pneumonias, 4 of the right lung and one of the left, and one case of right bronchial pneumonia with diaphragmatic pleurisy. There were 2 cases of pneumococcic peritonitis which were mistaken for peritonitis caused by appendicitis and at least 2 cases of mesenteric lymphadenitis.

In one child of 2 years of age an abscess mass was mistaken for an intussusception. In another, a non-rotated cæcum with a perforated appendix situated under the liver caused a delay of two days in time of operation. And in 2 other children inflamed appendices which were adherent to the bladder caused urinary symptoms.

Hospitalization.—Of those who lived, the number of days spent in the hospital bore direct relation to the time at which the operation was performed after the first symptoms appeared, and consequently upon the time at which the diagnosis was made.

TABLE IX.
Relation of Time of Operation after Onset of Disease to the Time Patient Spent in Hospital.

Time sick before operation	No. of cases	Mean time spent in hospital
1 day	43	16.9 days
2 days	29	20.6 days
3 days	26	23.6 days
4 days	12	29.9 days
5 days	7	34.6 days
6 or more days	17	25.5 days

Those cases which were closed without drainage spent an average of 14.2 days in the hospital; the unperforated appendices, which were drained, 19.1 days; spreading peritonitis 24.6 days, and the abscess cases 27.6 days; the average number of days for all cases was 22.3.

Conclusions and Comments.—The outstanding fact brought out in this analysis is that an early diagnosis with operation reduces mortality, prevents development of complications, shortens convalescence, and makes sequelæ, such as incisional hernia, less apt to develop. While this is not new, since every recent statistical paper on acute appendicitis has demonstrated the same, it is worthy of repeated emphasis.

The incidence of the disease in children is of interest. In the very young (under five) it is a comparatively rare condition, gradually increasing in frequency until adolescence when its occurrence is as common as in the young adult. Bancroft * in his series of 584 cases had 65, or 11.1 per cent., in the first decade, while the author † in a previous analysis of 500 cases had 42, or 8.4 per cent. Our youngest case was 20 months and only 11.7 per cent. were under the age of 5 years. Undoubtedly in a large number of children under 5 years of age acute appendicitis is not recognized; but yet the incidence would not seem to be as great as in the second five years of life.

The morbidity and mortality has an inverse relation to the incidence. In the young (under 5 years) the prognosis is grave, almost all perforate (100 per cent. in this series), and the mortality among these was 35 per cent. As the age increases the mortality decreases. For the second five years it was only 3.1 per cent.; for the whole of our series 7.5 per cent., and for the first decade 9.8 per cent. Bancroft showed a mortality of 10.9 per cent. for the first decade and 2.4 per cent. for the second decade, and Beekman, Smith and Everingham had 16 per cent. for the first and 1.2 per cent. for the second. The higher mortality in the young would appear to be due first, to difficulties in the diagnosis, and second, to the failure of the peritoneum to wall off the process and the lack of resistance of the individual. As adolescence is approached the resistance of the body is increased and peritonitis is less commonly seen. If the cases under five years of age were eliminated our mortality would have been 3.9 per cent. instead of 7.58 per cent., which is approximately the same as is found among adults, Bancroft's mortality being 4.2 per cent. and the author's previous series 6.8 per cent. In children, if operation is performed before perforation takes place, the mortality should be almost nil.

Acute appendicitis is twice as common in boys as it is in girls, but the mortality for the latter is double that of the former. This is similar to conditions found in the adult. Bancroft had 63.7 per cent. males, 36.3 per cent. females, with 3.7 per cent. mortality of males, and 5.2 per cent. females.

Perforation is much more common among children than in adults and spreading or diffuse peritonitis is relatively more frequent than abscess formation.

	Spreading peritonitis	Abscess
This series (children)	34.4	36.4
Bancroft (all ages)	10.8	22.8
Beekman, Smith and Everingham (all ages)	9.0	21.0

The mortality of cases with spreading peritonitis or abscesses is about the same as found in a general series.

The convalescent post-operative complications, with the exception of secondary abscesses, developed in about the same numerical proportion as in the adult, though they were not as varied. We did not see any cases

* Jour. Am. Med. Assn., 1920, vol. lxxv, pp. 1635–1638.

† Beekman, Smith and Everingham: Am. Jour. Med. Sc., 1917, vol. cliv, p. 490.

with post-operative phlebitis or emboli. Secondary abscesses were much more commonly found than in a general series. We had 10.3 per cent. of these, Bancroft 4.2 per cent., and Beekman, Smith and Everingham 2 per cent. This may be accounted for by the apparent fact that children wall off infection with adhesions slower than adults allowing a dissemination of pus among the coils of intestines. No serious complications developed in any of our undrained cases.

Incisional hernia followed operation for acute appendicitis much more frequently than in adults; in this series 12.8 per cent. Bancroft reports for the first decade 17.1 per cent. and for his general series (all ages) 9.8 per cent. General bulging of the muscles to the mesial side of the scar, which was so often found shortly after operation and which later disappeared, was probably due to transitory injury to the innervation of this part of the muscle and was corrected when the axis cylinders of the efferent nerves were reëstablished. Bancroft reports the same condition in adults, which he did not class as hernia.

Predisposition to hernia is more common in younger children than in those approaching adolescence. This can be explained by the apparent poorer resistance to infection, with a longer convalescence, and less highly developed musculature.

All the cases that later developed hernia, except one, had some loss of tissue of the abdominal wall or a separation of the edges of the wound. The loss of tissue was from sloughing in wounds that had become badly infected from the secretion about the drains. The amount of slough apparently depended upon the virulence of the infection and interference with blood supply by sutures or the pressure of products of inflammation confined between tissue planes. It would seem that the important factor is the breaking down of the wound in the peritoneum. The peritoneum is adherent to the transversalis fascia. When closed the two are sutured as one, the plane of the serous surface remaining parallel with the planes of the abdominal wall and being strengthened by the transversalis fascia. This should prevent protrusion of abdominal viscera until the other elements of the abdominal wall have healed. If the wound in the peritoneum sloughs, the edges of the peritoneum and transversalis fascia are separated and there is also sloughing of the superficial layers and more or less protrusion of abdominal contents. The serous surface now closes over by continuity, the edges of the transversalis fascia remaining separated. As the edges of the serous surface advance they are deflected outwards by the protruding viscera and finally come in contact with the under surface of the skin, which is also healing by continuity. The peritoneum adhers to skin and prevents the edges of the separate layers of the abdominal wall from coming into contact with each other. Thus if sloughing of the wound is prevented, hernia should follow less frequently.

Bancroft states that upon the Second Surgical Division of the New York Hospital, " It has been the general principle to make the incision in the fascia

and muscles comparatively small in order to diminish post-operative sloughing in the drained cases; when the incision is large it is necessary to suture the aponeurosis, thereby burying foreign bodies and interfering with the blood supply of a tissue, early subject to bacterial infection." * * * "In the case in which drainage is employed, if the incision is small, only the peritoneum is united about the drain, no sutures being placed in aponeurosis, muscle or skin." With the above procedure the peritoneal edges are coapted, and as there are no products of infection in close contact and under pressure to interfere with circulation, the peritoneum heals by primary union, its continuity being in its original plane and not out towards the skin surface. The muscle bundles tend to come together over it because of the direction of their pull, but do not inclose infectious material which might otherwise cause necrosis of tissue, and the aponeurosis and skin, being left wide open, allow free drainage. In recent cases drained in this manner the wounds heal with no sloughing, their surfaces being covered only with a small pyogenic membrane which soon disappears. The muscle fibres adjust themselves over the peritoneum which has healed by primary union, and complete healing of the wounds is shortened, as they do not need re-opening to allow for drainage of sloughing tissues.

Like most diseases in childhood acute appendicitis starts abruptly, the child suddenly being seized with acute abdominal pain and soon after vomiting. Vomiting is an almost constant symptom, being present in 85 per cent. of the non-perforated cases, 97.7 per cent. of the peritonitis cases and 83 per cent. of those with abscesses. It is such a common practice to give cathartics to children as soon as they complain of pain in the abdomen that almost all of the patients admitted to our wards for appendicitis have had some form of purgation. If they had not vomited before, they usually emptied their stomachs after its administration. It would seem quite probable that cathartics are accountable for a large number of the early perforations which take place in children.

All children with acute appendicitis show some rise of temperature; it is seldom high, usually under 103°. Cases with spreading peritonitis usually have a higher reaction than those with abscesses or the unperforated cases.

The pulse is accelerated in all cases but is not as rapid as might be expected, except in those who are markedly toxic.

The respiratory rate appears to be increased, apparently in proportion to the amount of peritoneal surface involved, as it is highest in the perforated cases and lowest in the non-perforated.

Apparently more can be told of what condition is present from careful examination of the abdomen than by any other means. In the unperforated cases the tenderness and rigidity was usually pretty well localized on the right side of the abdomen, while in the cases suffering from diffuse peritonitis these signs were quite uniformally general. In the unperforated cases the rigidity at times was absent. With abscess formation the tenderness was well localized with right-sided rigidity and oftentimes a mass was felt either

by abdominal or rectal palpation. It must not be forgotten that at times the cæcum is not completely rotated and the physical signs are not what might be expected.

The leucocytes and differential counts are of importance to confirm diagnosis, but are of little value from a prognostic standpoint. They are always higher than normal. The number of leucocytes is seldom larger than 30,000 and polymorphonuclears higher than 94 per cent. As a general statement it can be said that cases with abscesses have the highest counts, spreading peritonitis less, and the unperforated cases have the lowest.

Mistakes in diagnosis would seem to be inevitable but should be reduced to a minimum. Differentiation of early pneumonia with abdominal symptoms before definite physical signs appear in the chest is difficult. It would seem to be better to err on the side of operating than to wait with the danger of a diffuse peritonitis. Mesenteric lymph adenitis and pneumococcus peritonitis are often mistaken for acute appendicitis. Convalescence can be much shortened by operating upon cases early in the disease, before drainage is necessary.

SUMMARY

1. The earlier diagnosis is made and operation performed, the lower is the mortality, the fewer are the complications and the shorter is the convalescence.

2. Acute appendicitis in children is more frequent as adolescence is approached.

3. With the exception of children under five years of age, in whom it is extremely high, the mortality is about the same as is found among young adults.

4. The disease is found twice as commonly in boys as in girls, the mortality being about twice as great among girls as boys.

5. Perforation of the appendix with spreading peritonitis or abscess formation occurs more often in children than in adults.

6. Immediate post-operative complications are as commonly found in children as in adults, with the exception of secondary abscesses which are seen more often.

7. Incisional hernia follows operation in children more often than in adults. Sloughing of muscles and aponeurosis, secondary abscesses and partial evisceration of portions of the abdominal contents appear to be the causative factor.

8. Mistakes in diagnosis would seem to be inevitable and it would appear better to err by operating.

In conclusion I wish to express my thanks to Dr. Carl Burdick, who is in charge of the Children's Surgical Service, 4th Division, Bellevue Hospital, for the privilege of reporting these cases.

FRACTURE OF THE ANTERIOR SUPERIOR SPINE OF THE ILIUM BY MUSCULAR VIOLENCE*

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Fractures by muscular violence, while rare, are always of interest, especially in the mechanism of production. Fracture of the anterior superior spine of the ilium in this fashion has occupied the attention of surgeons since 1870. Matti [1] and Ruppert [2] consider it a typical avulsion fracture, relatively infrequent, and Cotton [3] and Speed [4] think it rare. To those who came before the inception of the X-ray falls a great deal of credit for the accuracy and precision with which this diagnosis was made.

The anterior superior spine is developed from the iliac crest, one of the five secondary developmental centres of the os innominatum. John Poland [5] states, "some osseous granules which show themselves in the cartilaginous margin of the iliac crest, congregating especially at two points—in the front and back parts to form the anterior and posterior spinous processes—are often seen at the fifteenth year. Beclard fixed the commencement of the osseous development at the sixteenth year. At the nineteenth to twentieth year two thick and broad epiphyses are seen, the anterior one forming the anterior superior iliac spine and the anterior three-fourths of the iliac crest, the posterior one the posterior superior iliac spine and contiguous part of the crest. More often these two parts are united into one long epiphysis capping the iliac crest. This epiphysis does not join the body of the ilium till the twentieth to the twenty-fifth year, usually at the twenty-first year." Doctor Orr, quoted by Albertin,[6] and also Dwight [7] are in accord with this development. A separation, then, of the true osseous epiphysis can only occur from the fifteenth year, the time of its formation, to the twenty-fifth year, its union with the body of the bone. The anterior superior spine has attached to it numerous muscles: The sartorius, tensor fasciæ femoris, external and internal oblique, transversalis, gluteus medius, the iliacus on the inner aspect, the fascia lata and Poupart's ligament. The periosteum forms a strong sheath about the epiphysis, so much so that on its removal the epiphysis may be readily detached from the body of the bone. The blood supply of the epiphysis comes from the periosteal network of arteries and one or two small vessels from the diaphysis, which perforate the conjugal cartilage. So a separated epiphysis does not necrose because its blood supply is almost entirely independent of that of the rest of the bone.

As to whether this is a fracture or an epiphyseal separation, there is some discussion in the literature. Tanton [8] says that it can occur as an epiphyseal

* Read at The Orthopædic Section, New York Academy of Medicine, May 18, 1923.

separation in an infant and an adolescent up to sixteen or seventeen years, the age of ossification of the spine. In an editorial article, Lancet [9] states, "As the epiphysis of the spine does not unite with the body of the bone until the twentieth to the twenty-fifth year, these accidents may be regarded as separation of epiphyses." On the other hand, the Dictionary of Dechambre-Poirier-Testut claims an epiphysis only for the anterior inferior spine. McHenry,[10] as one of his conclusions, gives the following: "In all cases the diagnosis might be said to be a separation of the epiphysis rather than a fracture of the anterior superior spine of the ilium, but in each case the whole epiphysis was not separated (*i.e.*, the iliac crest in its entirety) but only a small portion of it which has no separate centre of ossification from the rest of the iliac crest, and therefore 'fracture' seems to be after all the more correct term." Turner [11] states, "the anterior superior spine is developed as part of the secondary centre from which the whole iliac crest arises, so that its separation is not complete without fracturing across the remainder of the epiphyseal plate. It cannot, therefore, be considered as a pure diastasis." The inclination of the writer is to favor the opinion of the last two men.

The mechanism of the production of this fracture is interesting. The keynote is hyperextension of the trunk on the thigh. Corlette [12] lays great stress on the sudden contraction of the sartorius. Rieffel [13] feels that this fracture is caused mostly by a contraction of the fascia lata. The lesion most common is that which detaches the spine along with a part of the crest. In this connection it is also interesting to note that Tanton [8] observed a similar fracture in young race horses, which, however, he could not verify in the veterinary literature. Stimson [14] says, "considering the strength of the muscles attached to the ilium and the occasional correspondence of the fragments to the insertion of the muscles, the theory (muscular action) does not seem unreasonable." Reverdin [15] thinks that to regain the equilibrium the trunk is flexed on the thigh. The flexors, the sartorius, and the tensor fasciæ femoris are in active contraction. In slipping there is hyperextension of the trunk on the thigh which causes a violent contraction to bring the body forward. In the opinion of Albertin, epiphyseal separation by contraction of the muscles attached to the bony parts is rare, but a violent muscular contraction can break the continuity of the parts at the level of the cartilage. In discussing his case, Brown [16] says that on taking off before jumping, the pelvis is raised suddenly by the action of the muscles which lie between the ribs and ilia. In a long "take off" with the right foot, the strain will be greater on the right side, and *vice versa*. Tanton [8] is convinced that the fracture is most commonly due to muscular action. Ruppert [2] attributes it to the muscular action of the sartorius, gluteus medius and tensor fasciæ femoris. Speed [4] gives the following mechanism as probable: "In running the leg involved is stretched way out behind as a step is being taken with the opposite leg. The ground may give way or the foot slips, so that simultaneously with the hyperextension an outward rotation of the leg takes place. This passes the limit of extension permitted in the hip-joint and the spine is pulled off by the muscles attached

to it." According to Matti [1] there is an uncoördinated action of the muscles when anyone tries to straighten out in slipping. Tillmans [17] mentions the fracture as due to the pull of the tensor fasciæ femoris and sartorius.

The following case is presented as belonging in the group under consideration:

A high school student of fifteen presented himself in April, 1921, complaining of severe pain in the region of the right groin, especially on walking, which he had for one day. His past history was irrelevant. The day previous, while running a relay race, he found that after about fifty yards, he was incapacitated because of a knife-like pain in the right groin. On close questioning he volunteered the following information. In preparation for the race he assumed the "take off" with the left foot in front of the right. On the "take off" with the sudden straightening of the body, he was partially disabled by the severe pain described before, and by a snap which he felt in the right groin. After quitting the race, he walked to a car with a limp and then continued part of the time to walk about his home. The next day he descended two flights of stairs and all-in-all walked about five blocks to see me. On examination he was seen to walk with a distinct limp on the right side and with the trunk bent forward and to the right. Hyperextension and hyperflexion of the thigh on the pelvis were possible only with great difficulty because of pain in the iliac region. There was a little fullness in the anterior portion of the iliac crest, and here there could be felt a piece of bone about 2½ cm. in diameter which moved slightly on the deeper parts, with crepitus. This area was exquisitely tender. There was only slight ecchymosis. A tentative diagnosis of fracture of the anterior superior spine was made and the patient was referred for immediate X-ray, (Fig. 1) which confirmed the diagnosis. The anterior superior spine was torn from the epiphysis of the iliac crest completely, and was rotated outward. The patient had an oblique strapping applied and was advised to ride home and

FIG. 1.—X-ray picture taken twenty-four hours after the injury, showing complete detachment of the anterior superior spine.

stay in bed for two weeks with a pillow underneath the knees. Here the patient fell out of my hands and consulted Dr. William F. Campbell, of Brooklyn, who has been kind enough to allow me the use of his notes. In two weeks, the patient was discharged with the anterior superior spine firmly united to the body of the bone and with practically perfect function. At the time of this report, two years later, the boy still continues his athletics and has no symptoms or disability from his fracture.

It is quite evident that the mechanism in this case was hyperextension of the trunk on the thigh and a strong pull of the sartorius and tensor fasciæ femoris.

The following cases have been recorded in the literature, the last of which, however, is a verbal communication from Dr. Leo Mayer of New York:

Joy and McWhinnie.[18]—A medical student of seventeen was in a foot race in which he had to turn back. In the exertion of turning he felt something snap, walked a few steps and fell. On examination the fragment of the anterior superior spine was felt and by placing the thumb over the origin of the sartorius and retaining the thigh, crepitus could be felt. The patient was put to bed with the thigh flexed and was well in two weeks without displacement of the fragment.

Seeley.[19]—A young man of seventeen of good muscular development while running vigorously in a football match, was suddenly brought to a stand-still by a snap in his side followed by a feeling of "coming in two." Being quite unable to take another step, he was carried to the house and on examining him an hour afterwards, considerable tenderness was found along the upper head of the rectus femoris and a piece of bone as large as the top of the finger detached from the ilium. Crepitation was very distinct.

Hyde.[20]—A young man of eighteen, while running over some uneven ground, suddenly felt as if a stone had been thrown at him striking him on the hip and then he felt that he could not move again. He was carried home and on arrival an hour afterwards, it was found that he was unable to draw his legs forward and one head of the rectus femoris was torn from its attachment to the ilium with a piece of the bone, about the size of a half damson, perfectly movable, so much so, that distinct crepitus could be felt by moving the surfaces of the fractured parts together. The thigh was flexed and a pad applied with a figure-of-eight bandage around the pelvis and thigh. At the end of two weeks union had taken place with formation of callus and in another week was able to walk about without difficulty.

Brown.[16]—A strong boy of seventeen was long-jumping in the course of some sports on March 18. Just as he was commencing to jump, after having finished his run (taking off in technical language), he felt a sudden snap on the right side of the pelvis and fell being in considerable pain. He fainted and was carried indoors. When seen about fifteen minutes after the occurrence he got over his faintness but was a little shivery and collapsed. On examination, it was found that he could not stand and though each hip joint moved naturally, movements in the right hip joint caused pain in the lower part of the abdomen on that side. Coughing and passing water also caused pain in the same place. The right anterior superior spine was not to be felt in its place but a rough piece of bone was felt instead of it. All around this was a considerable hæmatoma while the spine itself was dintinctly felt displaced upwards and a little inwards. With the abdominal muscles relaxed it could be brought back to its proper position and marked crepitus elicited, though of that soft character which is noticeable when epiphyses are detached. He was put to bed and kept literally on his back for ten days, the right hip being fixed with a stout spica and a pad of lint assisting to keep the displaced fragment in apposition with

the rest of the bone. In about a week the hæmatoma was reabsorbed and crepitus could still be elicited. At the end of a fortnight, he was allowed to move about a little, keeping the hip-joint fixed with a well-made elastic silk spica. By this time crepitus could no longer be elicited and after eight weeks he ceased wearing his support and felt in every way strong and well. This boy jumped from his right leg and called into sudden and violent action his external and internal oblique and transversalis muscles, separating the spine from the body of the bone.

ALBERTIN.[6]—A young man of seventeen, well built, had no antecedent disease of the skeleton. Two days previously the patient ran with moderate speed, when, due to an inequality in the level of the ground, the patient fell. The left leg was twisted inward and behind the right leg. Seeing that he was about to fall, he tried to recover himself by reversing the movements. He was then thrown obliquely backward on the left side but the body did not touch the ground. He lifted himself up as soon as he felt severe pain just external to the fold of the groin on the left side. He could not walk after the fall and limped. Examination showed no ecchymosis. Palpation of the anterior superior iliac spine gave definite tenderness. In endeavoring to ascertain more definite information concerning deformity, bony mobility was noticed corresponding to the triangular projection formed at the anterior superior spine of the ilium. One could grasp the bony fragment and make it slide deeper, giving definite crepitation. This mobility increased with flexion of the thigh on the abdomen and diminished with complete extension. The diagnosis of fracture of the anterior superior spine was then made. In fact, because of the insertion of the sartorius at this level, the release of this muscle permitted mobility of the bony portion above its insertion. Flexion of the thigh on the pelvis, adduction and external rotation increased the mobility of the detached fragment. Extension, adduction and internal rotation fixed the fragment. This phenomenon of immobilization of the epiphysis appears to be due more or less to complete integrity of the periosteal sheath, thus, bringing about that the epiphysis, although detached from the bone at the level of the cartilage, nevertheless, remains adherent because of its periosteal covering. Flexion of the thigh on the pelvis was not stopped but it was done with difficulty. Besides, in trying this movement the patient experienced a sharp pain at the upper insertion of the sartorius. We have clearly a case of detachment of the anterior superior spine by violent contraction of the sartorius. The patient is very positive on this point. The left hand alone touched the ground. The manner in which the fall was produced, the sudden recovery and backward turning required a violent muscular contraction. That bony portion which takes its insertion above the sartorius was torn during the effort. The treatment was rest in bed without an apparatus because of slight displacement of the fragment. In eighteen days there is a large callus at the level of the tear and the patient walks without pain.

NICKERSON.[21]—A boy of seventeen, while running a foot race of 100 yards was brought to a stop by a feeling of something giving way in his hip with a sensation of the bones grating together. He could not take another step. On examination, the large fragment of the anterior superior spine could be felt, there was crepitus and tenderness. The leg was placed in the flexed position, the patient began to walk continuously at the end of two weeks with crutches and in three weeks dispensed with them, though using care in going up and down stairs.

HAMILTON.[22]—A man of seventy, after riding in a railroad car, in about one-half an hour, arose to leave his seat when he "felt something wrong" in his right groin and found himself unable to walk again without great pain. He was admitted to Bellevue Hospital the same day and a fracture involving about three inches of the ilium including the anterior superior spinous process was found. It was inclined to fall outwards but was easily replaced with distinct crepitus.

Corlette.[12]—A young man of seventeen years and eight months was getting down from the top of a bus from behind, when the bus suddenly went forward causing him to slip and loose his footing. He came down with his whole weight on the right foot and immediately felt a pain in the region of the anterior superior iliac spine. He fell forward and could not rise. On being assisted up, he could stand on the left leg but could bear very little weight on the right, the attempt causing pain. When examined and made to stand, he stood bent forward with the right hip and knee partly flexed with the toes touching the ground and turned slightly inwards. On lying down, passive movement of the hip could be done freely without causing pain so long as the hip was not extended beyond a certain point. On comparing the two sides, there was an evident loss of prominence over the situation of the right anterior superior spine where the patient complained of pain. Manipulation caused great pain; closely localized and distinct crepitus was obtained at the spot complained of. There was no pain or tenderness anywhere else. The patient was treated by fixing a high pillow beneath the knee, thus flexing the hip. A considerable amount of callus subsequently formed.

Reverdin.[15]—A muscular young man of nineteen at the moment of the break in a wrestling match on slightly sloping ground, experienced a twinge of pain but at the instant of bringing his right leg in front, the left slipped on the ground. He made an effort to right himself at the same time, feeling at the level of the anterior superior spine a sudden severe pain. He noticed at the same time that he could not stretch his leg and he let it fall voluntarily to the ground. He could not walk. The limb was put in semiflexion by cushions and a bandage was applied with the idea of obtaining good approximation. Five hours later, on examination, there was very little swelling. Active and passive movement of the thigh was impossible because of pain. A furrow was felt 3 or 4 mm. in length, the anterior lip of the furrow being several mm. lower than the posterior. Beyond the furrow is a movable bony fragment corresponding to the detached iliac spine. There is slight swelling in the neighborhood of the external iliac fossa. The thighs were put in semiflexion, wet dressings applied, and a course of massage begun. On the third day crepitus was elicited, the fragment was triangular, there was a half cm. difference in distance between the spine and the pubis. The fragment was depressed. Four days after, plaster cast applied embracing the two hips and upper part of the left thigh which was kept in flexion. On the eighth day through a window in the cast, the fragment was kept in position by a tampon of gauze and fixed by a spica. On the fifteenth day, the local condition excellent. The union was good but on attempted motion of the fragment pain was elicited. The furrow, on running the finger along the crest was one mm. in size. On the nineteenth day the cast was taken off, the fragment was well held, the patient walked without pain, extension and flexion being free. On the twenty-first day there was weakness of the limb and a slight furrow was still seen. There was a hard bony swelling due to the callus. On the left side the distance between the spine of the pubis was 1 cm. less than on the right. In about one month the patient could play tennis. The X-ray showed the fragment below and internal. The mechanism could be summed up as follows: The patient tried to regain his equilibrium by flexing his trunk on the left thigh. The flexors were involved in energetic contractions, and the sartorius and tensor fasciæ femoris which are attached to the anterior superior spine, on slipping, produced a movement of hyperextension of the trunk on the thigh which caused a violent contraction to bring the body forward.

Bebee.[23]—A young man of nineteen "was making a spurt in a 125-yard race, when he heard a snap and felt a sudden sharp pain in his right hip and a sensation of something giving way so that he put his hand on his hip to give support.

He felt pain on drawing his leg back relieved by bringing it forward but kept running and won the race." On examination forty-eight hours later, he walked with a limp. The anterior superior spine was blunted and vague in outline. It was very tender. Beneath this skin there was a hard angular mass movable without crepitus. Flexion of the thigh was painful. Two weeks later he walked without perceptible limp. In six weeks he could use his leg well.

BRICKNER.[24]—A boy of seventeen, a few hours before, had run a 100-yard dash. He started in a crouching position with the right leg drawn back. At the signal he pushed himself forward by this leg. At the same instant he "felt something snap." He was able to run, however, and with sufficient speed to make an excellent finish. He walked about after the race with but slight limp and suffered pain only on active flexion of the right knee (contraction of the sartorius). There was distinct mobility with crepitus of the right anterior superior spine. Recovery in three weeks.

STEINTHAL.[25]—This author just mentions seeing a case in a young woman who was dancing.

COTTON.[3]—A young man of nineteen was sprint racing when something gave way. He did not fall, but could not finish. A movable fragment could be made out displaced downward. There was pain on lifting the thigh and tenderness. Prompt union took place.

SKILLERN.[26]—A male, sixteen, during a foot race felt something snap in the upper part of the left thigh, but he finished the race. Pain was aggravated by flexion of the thigh. The lesion was shown by X-ray. It was probably caused by action of the sartorius.

MCHENRY.[10]—A boy of seventeen, on June 20, 1908, while running a foot race, completed it a winner and then came to a sudden stop, feeling something give way in his right side and pain. He could walk no further. On examination the boy was found muscular, he could not stand, and as he lay the right foot was turned inward, and he could not lift his heel from the table. There was found swelling, crepitus, and tenderness over the right anterior superior spine with no ecchymosis. When the knee was flexed, crepitus could be obtained. The fragment could be felt and moved, but less when the limb was extended. X-ray showed a fracture of the anterior superior spine with a fragment 3½ cm. long, with a shape and size of an almond, being displaced downward and inward. The fragment was replaced and held in fixation by a pad and strapping, with the leg flexed at the knee. On the twelfth day, there was no pain, tenderness, or crepitus. On the eighteenth day, he got about on crutches, and on the twenty-first day the X-ray showed firm bony union. In several days he attained a normal gait.

TURNER.[11]—This case was seen in 1897. The patient was a strong lad of eighteen, who was running very quickly when he felt something snap above or about his left hip. "He went out of his stride," and after struggling for a few paces, fell to the ground. He was seen in one hour and walked very lame with both the thigh and leg slightly flexed. The anterior superior spine could be felt separated from its attachment and crepitus was obtained. The next day an incision was made to the injury and it was found that the separated fragment carried the attachment of the sartorius with it, while the abdominal muscles attached to this part of the crest, were partially torn. The fragment was fixed to the ilium with silver wire. Recovery was uneventful, and when the patient was seen one and seven years later he had no disability.

AUER.[27]—A young man of twenty-three, in attempting to kick a football, missed it. He felt weak on his right side when he attempted to walk but he was able to limp to the hospital. He suffered little pain except on forward flexure of the thigh. Examination showed the skin over the anterior superior spine slightly

depressed. There was crepitus. The fragment was replaced and the thigh flexed and abducted.

RUPPERT.[3]—An eighteen-year-old servant was running a race and on the "take-off," with his right foot forward, he felt a severe pain in his right hip, which caused him to run a few more feet, and then he lay down on the ground. On examination he had pain in the region of Poupart's ligament on extension of the hip. He was able to stand on the right leg without trouble. The spine, the size of a nut, was about 1 cm. below the usual place and it could easily be felt and moved with crepitus. It was very tender. The patient was able to get about in a few days.

JAULIN.[28]—A young man of eighteen ran very fast in a race. All of a sudden he felt at the level of the anterior superior spine a severe pain, which made him

FIG. 2.—X-ray picture of Dr. Leo Mayer's case taken three weeks after injury, the arrow showing the detached fragment pulled down about 5 cms.

fall before the finish of the race. Dr. Le Page Rene made the diagnosis of separation of the right anterior superior spine. At this level there was abnormal mobility and crepitus. On the left, one could only make out flatness and pain. The loss of function was due most of all to the pain. The man could not walk, unless supported by two people. It was produced at the epiphysis not yet ossified.

MAYER, LEO, New York. (Verbal communication).—A young man of seventeen, while running in a football match was seized with severe pain in the right groin. He continued playing and walked about for three weeks with some pain. On examination there was marked tenderness just beneath the right anterior superior spine. About one inch below this, a hard mass seemingly bone, could be palpated. X-ray (Fig. 2) showed a fracture of the ilium and a downward displacement of the fragment of bone. On October 10, 1922, about 3½ weeks after his injury, operation was performed. A 5-inch incision from the anterior portion of the iliac crest downward over the anterior superior spine was made. On opening the fascia just below the spine, there was a gush of bloody serum and a cavity two inches deep by one and one-half inches long was opened up. The lower wall of this cavity was formed by a piece of bone the size of the terminal

phalanx of the thumb. By flexing the hip about 150° it was possible to bring this fragment of bone back into position and hold it there by two kangaroo tendon sutures. Plaster-of-Paris from ribs to knee applied. Eighteen days later, the bone was in excellent position. Twenty-five days after the operation, the patient could walk with a limp. In about six weeks, the patient walked well and the bone was firmly healed.

Conclusions.—From an analysis of the total number of cases, twenty-one, the following facts may be gathered:

1. The fracture is infrequent.
2. All the patients were males, a large percentage of whom were athletic and muscular. One case, not completely described, was in a female.
3. The average age in the epiphyseal stage is 17½ years, the youngest 15, the oldest 23. There was one case at the age of 70.
4. The etiological trauma was: Running vigorously, 50 per cent.; "take off," 16 per cent.; running over uneven ground, 9 per cent.; sudden turn backward, 5 per cent.; rising out of seat, 5 per cent.; slipping, 5 per cent.; wrestling on sloping ground, 5 per cent.; kicking, 5 per cent.
5. All had pain.
6. A snap was felt by 45 per cent.
7. The fragment was felt in 90 per cent.
8. All the patients limped, 76 per cent. had immediate disability, 11 per cent. walked a short distance, 1 case could walk 48 hours later, and 1 case walked about for 3 weeks.
9. The side involved is not given in six instances. One case had both sides fractured. Of the remainder, 75 per cent. were on the right side and 25 per cent. on the left side.
10. The average duration of the disability in the nine unoperated cases in which it is mentioned is 20 days. Two cases were operated, both of which had return of function in about one month.
11. The end result is excellent in all.

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ADDENDUM.—Forceful contraction of the sartorius as a cause of this fracture is assigned by Roberts and Kelly in their "Treatise on Fractures," 1916, and by William L. Estes, Jr., in Ochsner's "Surgical Diagnosis and Treatment," vol. iv, 1922.

PROGNOSIS IN GIANT-CELL SARCOMA OF THE LONG BONES*

BASED UPON THE END-RESULTS IN A SERIES OF 50 CASES

By William B. Coley, M.D.

of New York, N. Y.

(concluded from page 357)

HISTORIES OF THE MORE IMPORTANT CASES

In an earlier paper on the subject, the writer reported in full the following case: giant-cell sarcoma of humerus; amputation; death from metastases of lungs 15 months later.

Case I.—H. B., male, ten years of age, developed a rapidly-growing tumor of the upper end of the humerus, following a recent fracture. Five weeks later the tumor showed such marked signs of malignancy, that I performed an immediate shoulder-joint amputation. A microscopical examination was made by Doctor Ewing, who reported:

"The process in the humerus proves to belong in the class of giant-cell sarcoma. It consists of wide blood-space surrounded by thin strands of loose cellular tissue composed of spindle cells. The spaces are partly lined by giant cells and some few giant cells are found within the strands of tumor tissue. By far the larger part of the bulk of the tumor is made up of blood spaces. The tumor has exactly the structure of the giant-cell epulis, and I think, therefore, that it has the same moderate degree of malignancy."

About a year later, the patient developed physical signs of metastases in the lungs; his general condition rapidly deteriorated, and he died in August, 1911, fifteen months after operation. In reviewing this case, after the end result was known, Doctor Ewing stated that there was an error in the original diagnosis, and that it was a highly malignant osteogenic sarcoma. The fact remains, that at the time of operation—the only time when the diagnosis is of vital interest to the surgeon and likewise to the patient—this tumor so closely resembled the benign giant-cell type that a pathologist of Doctor Ewing's great experience regarded it as such.

Case II.—*Benign Giant-cell Sarcoma of Upper End of Tibia.*—J. N., male, nineteen years of age; no history of injury; was admitted to the Memorial Hospital on June 29, 1919, with the following history: Two months before, curettage had been performed by Dr. Walton Martin, of St. Luke's Hospital, for a central tumor of the upper end of the right tibia, followed by an application of carbolic acid. The patient was then referred to the Memorial Hospital for prophylactic treatment. Doctor Ewing examined a section of the tumor, and pronounced it giant-cell sarcoma of the epulis type. Another microscopical examination had been made by Doctor Knox (Resident Pathologist of St. Luke's Hospital), who reported:

"Sections show only tumor tissue, very largely composed of atypical fibrous tissue, extremely vascular, and containing large numbers of giant cells and a very considerable amount of newly formed osteoid tissue. Hemorrhage and extensive

* Read before the Southern Surgical Association, December, 1923.

necrosis have occurred, but in the more actively growing parts, the stroma is found to consist of large oval or spindle-shaped nuclei twisted about in ramifying bundles. Giant cells are found in all parts of the section. They vary greatly in size and somewhat in form. The nuclei are oval and well defined. The bone formation is occurring in the more rapidly growing fibrous portions of the growth and shows small stellate or irregular oval areas in which calcification has already

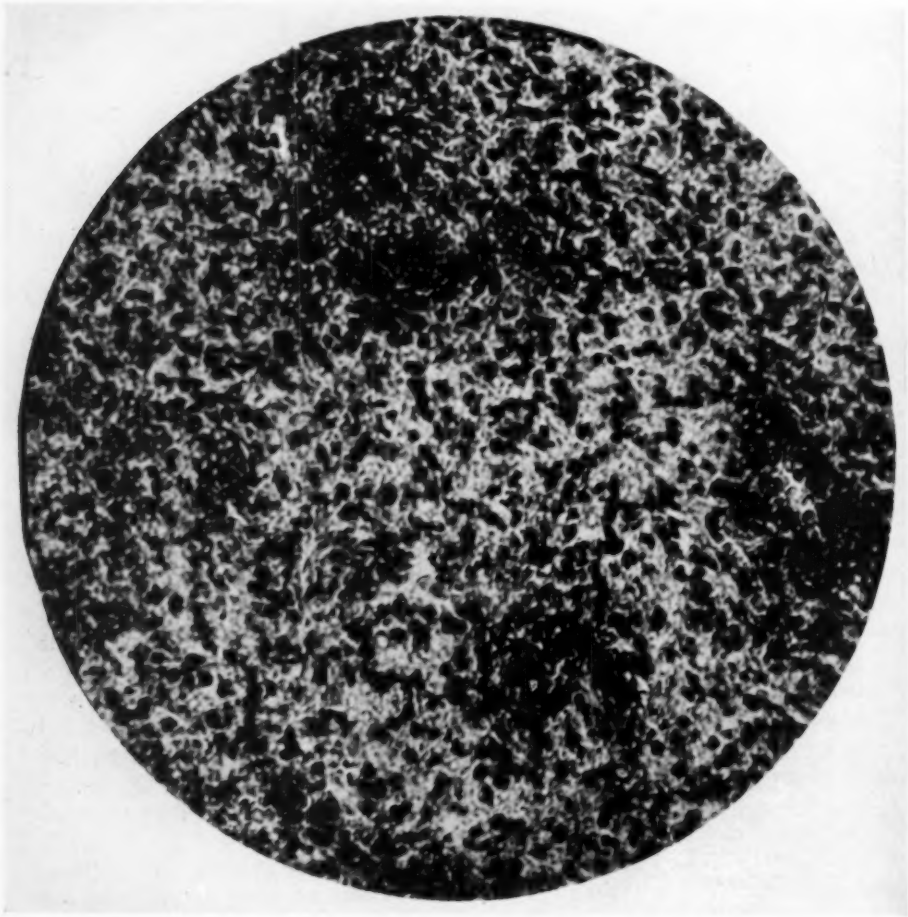

FIG. 30.—(Case No. 16 in text.) Giant-cell sarcoma of upper end of tibia with involvement of knee-joint. Toxins; radium; wound infected; amputation. Patient well 2 years later.

occurred. In places there is a homogeneous pink basement substance in which the cells are assuming the form of bone cells. Diagnosis: Osteosarcoma from head of right tibia. Contains giant cells." Report confirmed by Dr. Francis Carter Wood (Pathologist, St. Luke's Hospital).

At a conference of the members of the Memorial Hospital staff, it was decided that the case be treated with radium alone. Physical examination, at the time of his admission (July 16, 1919), showed a perfectly clean, healthy cavity in the upper end of the tibia. Into this cavity 47 mc. of bare tubes of radium wrapped in sterile gauze was placed and left there for 48 hours, a

total of 2256 mc. hours. The patient was then treated in the Out-patient Department during the fall and winter of 1919, the sinus being dressed two or three times a week. The cavity gradually healed up without infection and with apparently normal granulation tissue; but never entirely closed. In April, 1920, the sinus suddenly began to show increased discharge, quickly assuming a fungoid appearance, protruding slightly beyond the normal surface, showing all the characteristics of a recurrent tumor. Shortly after small hemorrhages occurred in the fungating mass, becoming more and more severe. The patient was re-admitted to the Memorial Hospital on May 24, 1920. On June 4, 1920, I performed a second curettage,

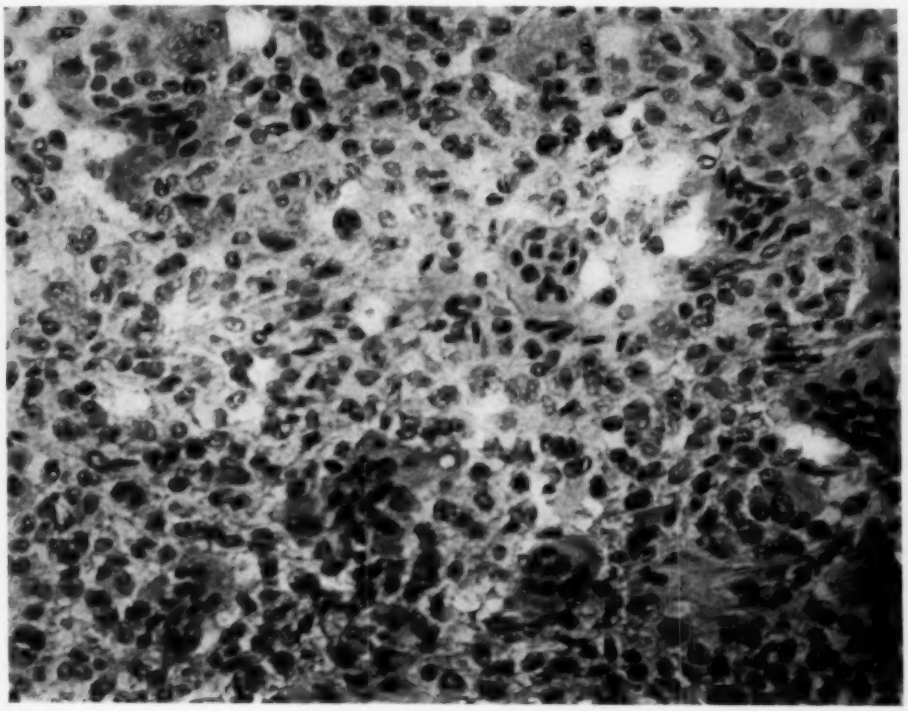

FIG. 31.—(Case No. 19 in text.) Myelogenous giant-cell sarcoma of lower end of femur; curettage; toxins; recurrence; amputation. Patient well 8 years later.

with removal of a large amount of tissue resembling partially degenerated sarcoma, extremely vascular, leaving a cavity the size of a small orange.

Doctor Ewing, who examined this tissue, stated that certain areas showed definite sarcoma, which he believed to be the same type as the original tumor, benign giant-cell sarcoma. The hemorrhages recurred following curettage, infection developed, and the patient's condition became such that it was necessary to perform an amputation. This was done on June 6, 1920. On section of the tibia, the whole upper end was found to be filled with a tumor mass which had nearly destroyed the cartilage, but not quite invaded the joint.

Microscopical examination by Doctor Ewing: "Section shows a large spindle-cell sarcoma with much œdema and widely dilated blood-vessels. It resembles malignant osteogenic sarcoma."

On reëxamination of the original section removed at primary operation, Doctor

Ewing again pronounced it a benign giant-cell tumor. In January, 1921, the patient began to show evidence of failure in general health, and soon developed unmistakable signs of metastases in the lungs. An X-ray picture taken showed both lungs completely filled with metastases. The patient became extremely weak and emaciated, and died a few weeks later.

It is interesting to note that the original section of this tumor was examined also by Doctors Bloodgood, Wolbach, Mallory, and Stewart, of Leeds, and all pronounced it a typical benign giant-cell sarcoma. On the other hand, Doctor

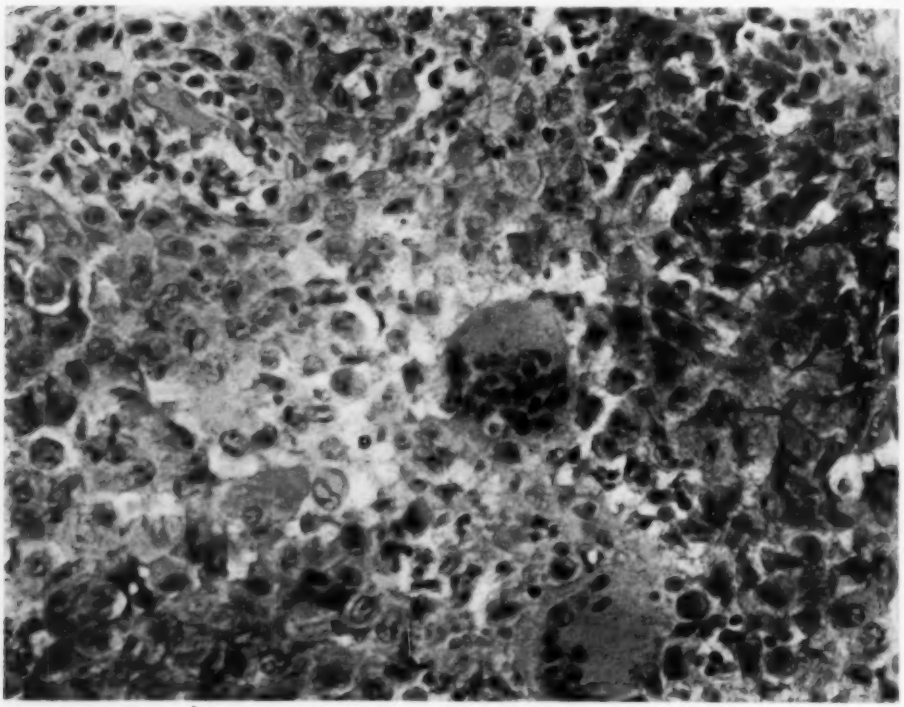

FIG. 32.—(Case No. 20 in text.) Central sarcoma of upper end of humerus; exploratory operation; toxins recovery; patient well 8 years later.

Wood believed it to be an osteosarcoma with giant cells, and Doctors MacCarty and Broder of the Mayo Clinic, pronounced it a definitely malignant tumor.

This case forms the basis of a recent publication by Doctors William S. Stone and James Ewing, entitled: *An Unusual Alteration in the Natural History of a Giant-cell Tumor of Bone* (*Archives of Surgery*, Sepember, 1923, vol. vii, pp. 280–296). These authors take the position that the tumor in this case was originally a benign giant-cell sarcoma. They state:

"It is the object of this communication to review the history of our knowledge of the giant-cell tumor of bone, exphasizing its invariable failure to produce metastases; and to record a case in which this rule was broken in the case of a tumor which completely altered its original structural character and proved fatal, with pulmonary metastases, apparently as the result of repeated insults from

attempted surgical removal, irradiation, and infection. * * * The record of the case presented is of interest from several aspects. The transformation of the structure of a benign giant-cell tumor, while evidently very rare and not previously recorded in this disease, finds a parallel in similar transformations that have occurred in many other tumors, benign and malignant, after surgical and other forms of trauma.

"The development of metastases in this case proves no exception to the rule that the benign giant-cell tumor never produces metastases. Here, the metastasizing tumor was not a giant-cell tumor, but a malignant growth that developed out of

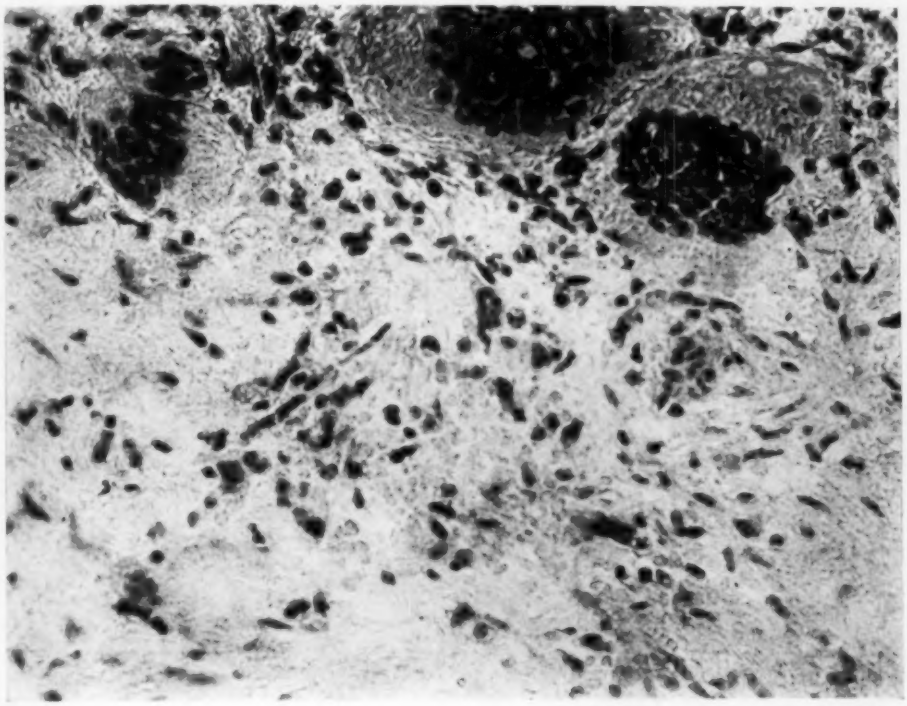

FIG. 33.—(Case No. 21 in text.) Central giant-cell sarcoma of tibia; curettage; toxins; recovery; patient well 8 years later.

a giant-cell growth, as the result of various insults, in which curettage and imperfect irradiation probably played the chief part."

I cannot agree with Stone and Ewing that here we had an original benign tumor which changed its original histological structure and ended in pulmonary metastases as a result of "repeated insults from surgical removal, radium, or infection." If it were a benign giant-cell sarcoma in the beginning, it should have been cured by the original curettage and carbolic acid, which, Bloodgood has long maintained, was the most approved and uniformly successful method of treatment of such cases. There was no infection in this case until eleven months after the primary operation, when a well-marked and rapidly growing recurrent tumor developed at the original

site. On account of the severe hemorrhages and infection developing after a second curettage, I amputated the leg eight days later. It seems to me more logical to believe that in this case we were dealing with an atypical variety of giant-cell sarcoma malignant from the beginning. In support of this opinion, it is important to note that the original sections of the primary tumor were pronounced malignant by Doctors F. C. Wood, of the Crocker Cancer Research Fund, MacCarty, and Broder, of the Mayo Clinic Laboratory. Bloodgood has repeatedly shown that curettage does not increase the malignancy of these tumors and his statistics give support to his opinion. Case III gives further support to this view inasmuch as the histological structure of the recurrent tumor was the same as the original tumor, "giant-cell sarcoma epulis type."

FIG. 34.—(Case No. 22 in text.) Giant-cell sarcoma of femur.

The practical conclusion reached by Stone and Ewing is, that, "The unfortunate outcome in this case suggests that the surgical plan of treatment if adopted in these cases, should be adhered to, and that it is unwise to attempt to combine surgical methods with post-operative radiation by means of radium inserted in the tumor cavity." While I agree with their view that the use of radium tubes inserted in the tumor cavity after curettage is unwise because it increases the chances of infection, I believe that post-operative radiation in the form of the radium pack or X-ray used a short time after curettage, is often of great advantage; and I have seen no ill effects from such use. It seems to me that another and very important conclusion can be drawn from this case, as well as from case No. 3, immediately following, and that is, that in both of these cases, early amputation as a primary measure in all probability would have saved the life of the patient; inasmuch as evidence of metastases did not occur for more than a year in one case, and nearly a year and one-half later in the other case.

It is clear, from these widely divergent opinions, that the surgeon is confronted with an almost hopeless problem; if he accepts the opinion of the pathologist, that the tumor is benign, and treats the case accordingly, he

may lose his patient later from metastases; on the other hand, if he amputates these cases as a routine measure, he is condemned for his useless sacrifice of limbs. It will afford little satisfaction to the surgeon to find, after the patient has died of metastases, that the pathologist, on reviewing the histology of the original tumor, has changed his opinion and believes the tumor to be

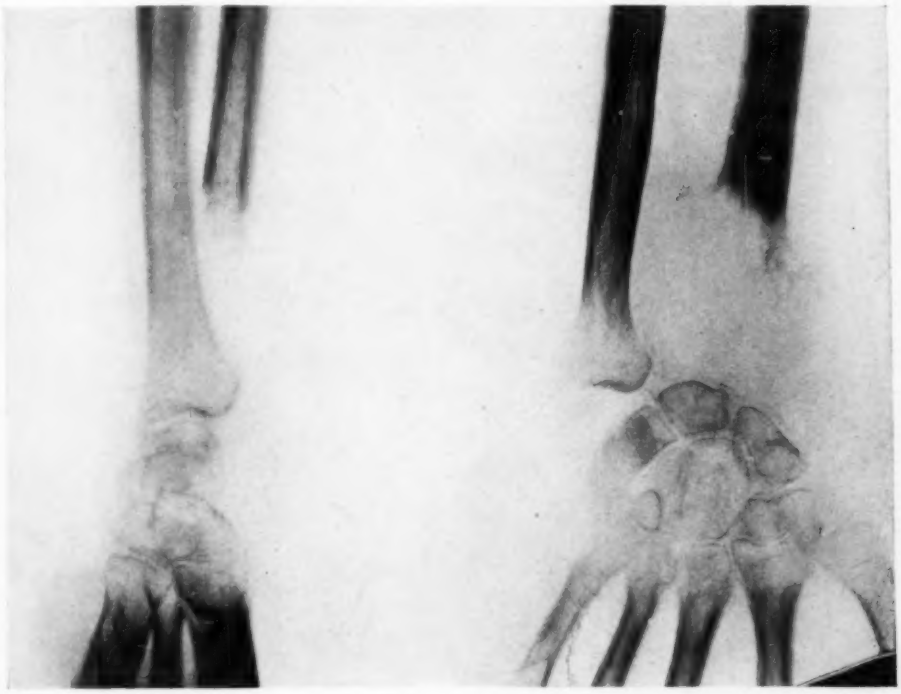

FIG. 35.—(Case No. 1 in radius tables.) View before treatment. Central sarcoma of radius probably giant cell; X-ray and clinical diagnosis.

either malignant from the start, or, a tumor that has become malignant on account of "insults" offered by the surgeon or radiologist.

In what way, then, must the surgeon meet this problem, and what course offers the best solution? I believe we will come nearer solving the problem by the closest coöperation between the surgeon, the pathologist, and the radiologist; and in the small group of cases in which there will be some doubt as to the diagnosis, after such coöperation, I believe the clinical evidence should out-weigh all other evidence in determining the method of treatment to be employed.

CASE III.—*Benign Giant-cell Sarcoma of Tibia; Treated by Repeated curettage, and Prolonged Use of Radium; Disease Not Controlled; Amputation; Local Recurrence; Death from Metastases.*—J. S., female, forty-four years of age, was admitted to the Memorial Hospital on March 15, 1921, with the following history: Pain in the tibia in May, 1920; admitted to the New York Hospital in October, 1920, on the service of Doctor Poole. A central tumor of the upper end of the

tibia was found, and curettage was performed in the latter part of October, 1920, with implantation of fat.

Microscopical examinations made by Doctor Elser, pathologist to the New York Hospital.

"October 30, 1920. Specimen consists of a large quantity of irregular pieces of tissue, rather firm in consistence and homogenously yellow on cut surface. Microscopical: A frozen section presents the features of a giant-cell sarcoma."

"November 16, 1920. Specimen consists of several pieces of firm, white tissue, more or less surrounded with blood clots. Microscopical: A section of one

FIG. 36.—(Case No. 1 in radius tables.) View two months later.

of these pieces of tissue presents the features of a giant-cell sarcoma similar to the original growth. A section of another piece is seen to consist chiefly of fibroblasts with irregular groups of medium-sized giant cells in this tissue."

"November 19, 1920. The structure of this tumor suggests that it is not the usual type of central giant-cell sarcoma of bone. The embryonal character of the unicellular elements, the abundance of mitotic figures, some of which are atypical, the excellence of nutritional condition (practical absence of necrosis and hemorrhages) differentiates this growth from the usual central giant-cell sarcomas. The growth bears all the evidence of malignancy and the early recurrence is not surprising. The case illustrates the fallacy of regarding all of these growths benign and curable by simple curettage. Certain tumors of this class are not only locally malignant, but give rise, though rarely, to generalized metastases. In this case, the use of radium or X-ray is advised as against amputation of the limb. Opportunity for dissemination has been given and if dissemination has occurred, all curative measures are futile. If dissemination has not occurred the X-ray

or radium is believed to be quite as effective as the knife. X-ray pictures of the lung should be made now, for comparison with others taken later at short intervals. Early appearance of new growths in the lung would indicate dissemination occurring during or before operative interference, and should not be charged to failure to amputate. If metastases occur late and the growth is not checked locally, the case would be a valuable lesson to X-ray and radium enthusiasts, and if metastases occur at all, it would be a valuable lesson to those claiming absolute benignity for this type of growth."

"November 23, 1920. Specimen consists of a white nodule, 1 cm. in diameter,

FIG. 37.—(Case No. 1 in radius tables.) View nine months after treatment.

covered with blood. Microscopical: A frozen section of the nodule presents the features of a giant-cell sarcoma, similar in its appearance to the sections previously made in this case."

Three other specimens were removed, and examined microscopically; Doctor Bancroft pronounced them:

1. Fat transplant which had become necrotic.
2. Necrosis (following radium).
3. Necrosis (following radium).

Other specimens were examined by Doctor Elser, who reported:

"January 15, 1921. Specimen consists of an irregular piece of tissue about ½ cm. in diameter. Microscopical: Section shows the features of a giant-cell sarcoma. At one end of the section there is a slight amount of necrosis with fibrin and blood."

"January 18, 1921. Specimen consists of two small bits of soft tissue ½ cm. in diameter each. Microscopical: Both pieces present the features of a giant-cell sarcoma of bone, the cells being of the epulis type."

"March 11, 1921. Specimen consists of a piece of soft, red tissue about 1 cm. in diameter and ½ cm. thick. Microscopical: Most of the tissue consists of fibrin, necrotic tissue, red blood cells, polymorphonuclears, and a few epulis type giant cells. A small piece of tissue consists of a giant-cell sarcoma, resembling the original tumor."

After the second operation performed by Doctor Poole, at the New York

Hospital, radium treatment was begun in November, 1920, by Doctor Stone, and continued at the Memorial Hospital from March 16 to August 5, 1921, as follows:

March 16, 32 mc. bare tubes in finger cots inserted in upper portion of sinus.

March 20, 320 mc. in silver tubes were placed in sinus.

April 8, 4 areas were treated with radium pack. Examination May 4, showed considerable improvement in condition.

May 9, radium-pack treatment.

May 18, radium needles; 24 mc. were inserted for twenty-four hours.

August 4, Bare tubes; 57 mc. were inserted.

The patient was discharged from the hospital on August 5, 1921. At this time, X-ray and clinical signs showed that the tumor was not under control. Doctor Ewing's diagnosis in this case was "typical giant-cell sarcoma." Shortly after, she entered the Presbyterian Hospital, on the service of Doctor Auchincloss. Her condition became worse, and an amputation was performed at the middle of the thigh on October 26, 1921. A microscopical examination was made by the pathologist of the Presbyterian Hospital, who reported: "Giant-cell sarcoma of the epulis type." The disease recurred in the stump, and a few months later it extended into pelvis and spine, causing death, November 5, 1922.

This case with illustrations, will be published in detail by Doctor Bancroft in the near future. While there was no evidence of lung metastases, the gradually increasing pallor, and cachexia, could not be accounted for by the tumor in the stump. The X-ray picture of spine showed increasing lordosis and possible metastases in the lumbar region. Doctor Auchincloss, in his summary of the case, describes the tumor as one which spread up the thigh into the pelvis and spine.*

Case IV.—*Giant-cell Sarcoma of the Humerus.*—M. S. C., female, forty-six years of age, was referred to me by Dr. J. H. Reid of Troy, New York, on April 30, 1923, with the following history:

In February, 1923, the patient fell down five steps, striking on her shoulder and remaining unconscious for several minutes. Examination by Doctor Reid revealed a recent fracture of the juncture of the upper and middle third of the right humerus; transverse easily reduced. He stated that, with the exception of considerable œdema of the whole arm and apparently more pain than usual, the six following weeks were uneventful; then he found good union in perfect position; but the pain was very intense. Unfortunately, there was no X-ray picture taken at the time of the original accident; but eight weeks later, X-ray revealed what was apparently a malignant condition of the head and whole proximal fragment. Wassermann negative.

Physical examination, April 30, 1923, by Dr. Bradley L. Coley, showed the right upper extremity held in a sling; the elbow bent at an angle of 90°; the wrist flexed at an angle of 120°; fingers extended; œdema of the entire extremity, most marked on the dorsal surface of the hand. Practically all motions at the shoulder, wrist and fingers were attended with great pain; there was, perhaps, five per cent. motion of the elbow, flexion, and extension; the same amount of flexion at the wrist, with no extension; the fingers were practically flexed. Motion of all kinds at the shoulder was impossible. There was no localized tumor and no dilatation of superficial veins. The skin of the hand, besides being markedly œdematous, showed trophic disturbances.

An exploratory operation was done by Dr. Bradley L. Coley on May 15, 1923. Microscopical examination by Doctor Jeffries: giant-cell sarcoma; by Doctor

* I am greatly indebted to Doctors Pool and Bancroft for notes of the case while at the New York Hospital and to Doctor Auchincloss for the end-result noted at the Presbyterian Hospital.

Ewing: benign giant-cell sarcoma of the epulis type; by Doctor Bloodgood: benign giant-cell tumor.

The tumor slowly increased in size accompanied by a great deal of pain. The patient was first seen by myself on June 3, 1923. In view of the pathological diagnosis of benign giant-cell sarcoma, it was decided to try conservative treatment. She was placed upon systemic injections of the mixed toxins of erysipelas and bacillus prodigiosus, which were pushed to the point of producing a reaction temperature of 103. During early July, the swelling diminished one inch in size; the patient was able to move her arm somewhat more freely; but the shoulder was kept immobolized by splints. In the middle of July, she was admitted to the Memorial Hospital, and given a massive dose of radium over the front, back, and external part of the shoulder (12,000 mc. hours at 10 cm. distance). The patient returned home where the toxin-treatment was kept up by Doctor Reid.

FIG. 38.—(Case No. 1 in radius tables.) Well, May, 1923, five years.

An X-ray picture of the shoulder taken in September, showed an increase in the size of the tumor; examination of the lungs revealed no metastasis.

A picture taken in early November showed still further increase in the size of the tumor. Clinical examination shows that the tumor has extended into the pectoral region, apparently infiltrating the muscles. A swelling developed at the lower end of the radius two weeks ago, which on X-ray examination, proved to be metastases. February 1, 1924, patient still living; no definite evidence of lung metastasis, but condition hopeless.

CASE V.—*Giant-cell Sarcoma of Femur; Amputation; Death from Metastases Three Years Later.*—E. R., female, sixteen years old; no trauma. The patient had a tumor of the lower third of the femur of three months' duration. Clinical diagnosis: central sarcoma, malignant. Microscopical diagnosis: giant-cell sarcoma. The toxins were given for one month before resorting to amputation; only slight improvement. Amputation was performed by Doctor Jeffries at the Hospital for Ruptured and Crippled, followed by 32 doses of toxins. The patient remained well for nearly three years, and then died of metastases in the pelvic bones, and probably in the lungs.

CASE VI.—*Giant-cell Sarcoma of the Upper End of the Tibia; Amputation Matastases in Radius and Lungs; Death.*—S., male, fourteen years old, patient of Doctor M. M. Lucid of Syracuse, New York. Tumor of two months' duration following an injury; amputation performed on August 7, 1913. The patient

remained well until October, 1914, or fourteen months later, when I examined him and found a typical central tumor of the left radius; no amputation was done; and in the early part of 1915, he developed typical metastatic sarcoma of the ribs and pleura, and died in July, 1915.

CASE VII.—*Giant- and Spindle-cell Sarcoma of Humerus.*—R. F., female, fourteen years old. A shoulder-joint amputation was done at the Memorial Hospital on August 23, 1911. The toxins were begun two weeks later and continued at home by Dr. Louis I. Mason, of Willimantic, Connecticut. Only a few doses of toxins were given.

Microscopical examination by Doctor Ewing: giant- and spindle-cell sarcoma of epulis type. A local recurrence developed and increased rapidly in size; death occurred on October 28, 1911; there were signs of septic absorption and probable metastases to lungs. This case was undoubtedly a highly malignant osteogenic sarcoma and not the benign type, as shown by the clinical history and rapid return.

FIG. 39.—(Case No. 10 in femur tables.) Central sarcoma. Giant- and spindle-cell; exploratory operation. Toxins one year. Decrease in size. Rupture of popliteal artery. Amputation, 1912. Well ten years.

CASE VIII.—*Giant-cell Sarcoma of Humerus; Amputation; Death from Metastases.*—C. H., male, fourteen years old. In 1913, a tumor occurred at the site of a recent fracture which had been united by Lane plates; the latter had been removed six weeks later, on account of infection. A few weeks later, an exploratory operation was performed. Microscopical diagnosis: giant-cell sarcoma of mixed type. One year later, the patient was referred to me by Doctors McGannon and Neil of Nashville, Tennessee; at this time, examination showed extensive metastases in the femur, the ilium, and probably, in the lungs. Death occurred a few months later.

CASE IX.—(See case No. 2 in Femur Table.) Giant-cell sarcoma of lower end of femur; inoperable when first seen (1908). Exploratory operation was

performed by Doctor Winters. Microscopical examination: giant-cell sarcoma. The toxins were given for one month, with slight improvement; later, rapid increase in size; metastases developed in the iliac glands, and probably in the lungs; and the patient died two months later.

CASE X.—*Giant-cell Central Sarcoma of Femur; Amputation; Metastases in Iliac Region and Lungs.*—S. S., male, nineteen years, was presented at a conference of the Memorial Hospital staff on November 2, 1916, with

FIG. 40.—(Case No. 19 in femur tables.)

FIG. 41.—(Case No. 19 in femur tables.)

Benign giant-cell sarcoma of femur treated with X-ray; improvement; still under treatment.

the following history: Local injury, kick, one year before; swelling two months later. Local operation performed at Bellevue Hospital about one month later. In October, 1915, amputation performed by Dr. John A. Hartwell. In September, 1916, or eleven months later, the patient noticed a swelling in the right iliac fossa; rapid increase in size. At the time of first observation at the Memorial Hospital (November 2, 1916), physical examination showed the whole iliac fossa and hypochondriac region occupied by a markedly protuberant tumor, firm in consistence, and apparently springing from the retroperitoneal glands. Examination revealed evidence of lung metastases, although there was no X-ray picture taken at this time.

Shortly after performing the amputation Doctor Hartwell showed this patient before the New York Surgical Society, and a full history of the case with complete

pathological data was published in the ANNALS OF SURGERY, 1916, pp. 357–359. A microscopical examination was made by Doctor Symmers, who reported: "Section throughout the tumor, involving the cortical layer of bone, showed neoplastic growth composed of several types of cells. The most common variety was a large spindle-shaped, polygonal or round cell of abundant eosinophilic cytoplasm, and a round or oval nucleus which took the basophilic stain with varying degrees of

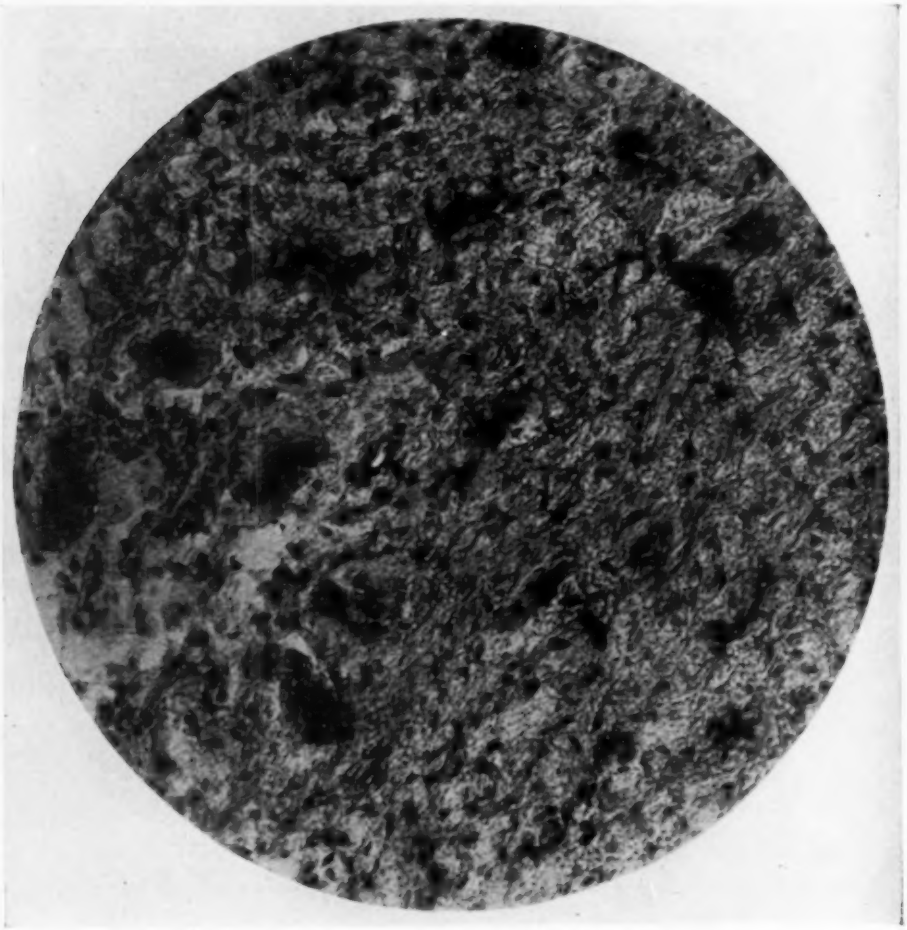

FIG. 42.—(Case No. 19 in femur tables.)

intensity. The cells lay closely packed together in a chaotic and irregular arrangement, and almost entirely filled the space between the bone trabeculæ. The picture was suggestive of a malignant sarcoma. Besides the mononuclear cells were numerous giant cells which could be roughly divided into two main types. Those in the central portion of the tumor showed numerous small nuclei, oval in shape and varying in number from 15 to 40, grouped in the central portion of a huge, irregularly formed, eosinophilic piece of protoplasm. They were like the giant cells found in specimens of epulis. The other giant cells were smaller, irregularly shaped, contained huge round or deformed nuclei about 2 to 5 in number. These

were large in proportion to the amount of cytoplasm, and were sometimes arranged so as to form a horseshoe. These were the giant cells so often seen in malignant sarcomata. In this specimen they were found near the cortical portion of the bone, more than elsewhere, but contain only a few red cells. The blood-vessels are distended, and there are a few hemorrhagic areas. The connective tissue is scarce, and for the most part fibrillar. The bone, except in the central portion where

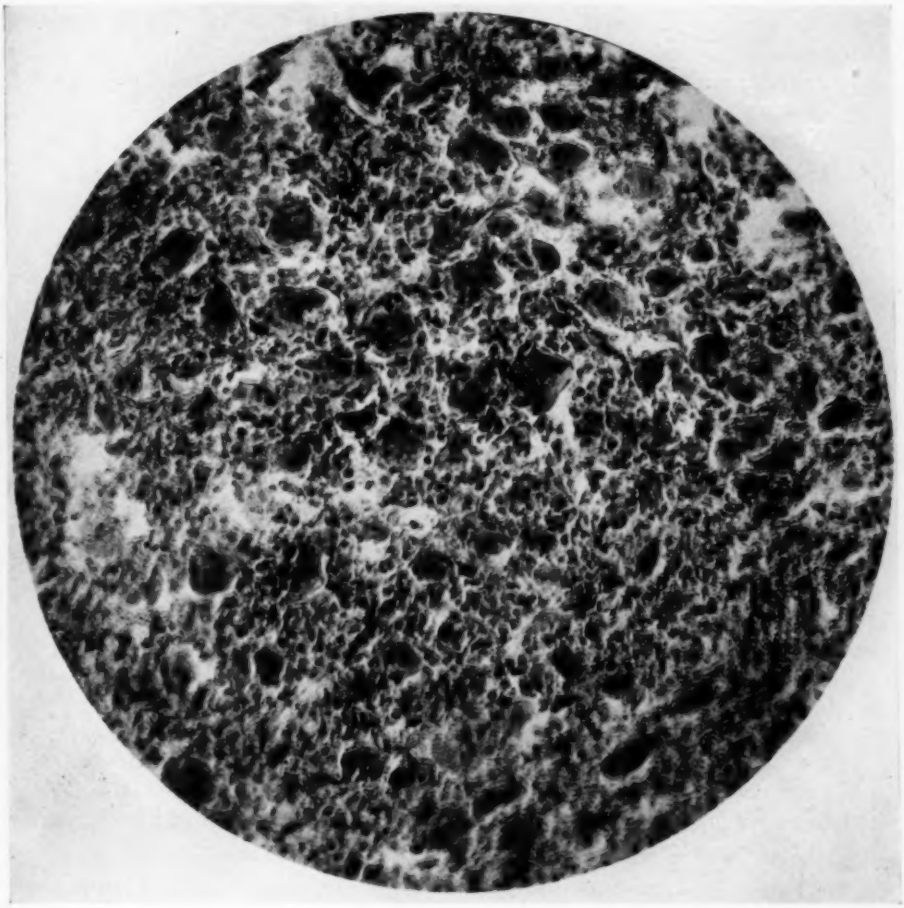

FIG. 43.—Giant-cell sarcoma of femur. Epulis type. Recovery under simple curetting. Amputation advised and refused. Well two years later.

it is undergoing lysis by the tumor cells, is normal. "Diagnosis: Giant-cell sarcoma of femur."

This case is reported not as an example of a typical benign giant-cell sarcoma causing death by metastases but as a case in which the two types of giant cells are found. If only one section were examined, it could easily be called benign giant-cell sarcoma.

CASE XI.—*Giant-cell Sarcoma of Femur: Amputation; Later Diagnosis; Malignant Osteogenic Sarcoma.*—Mrs. S., adult, first noticed pain in February, 1922; she was admitted to Bellevue Hospital for observation, for a period of eleven

days; no treatment. Several months later she went to the Flower Hospital where an exploratory operation was done, and a diagnosis of giant-cell sarcoma was made from a microscopical examination. She then received three radium treatments in the form of needles, and three X-ray treatments at another hospital. Six months later she entered the Hospital for Ruptured and Crippled where two casts were applied during a period of three to four months.

On March 10, 1923, she was admitted to the Memorial Hospital, at which time, physical examination showed a tumor occupying the lower six inches of the femur, apparently of central origin; there was marked swelling of the entire lower end of the femur and considerable loss of function. There was a radium burn over the outer aspect of the knee, and the patient was suffering intense pain.

X-ray diagnosis (Doctor Herendeen): Giant-cell sarcoma of distal end of femur. In March 12, 1923 it was decided to amputate on the ground that, while the tumor was probably of the giant-cell type, the patient was steadily growing worse, she was confined to bed; and even if the limb could be saved by X-ray or radium, it would be of little use, and there was no certainty that the pain could be controlled; amputation was accordingly performed.

Gross examination: of the amputated specimen showed a tumor occupying the lower end of the femur, beginning about 7 cm. from the lower end, at which point, there begun abruptly complete destruction of the bone. The tumor is globular in shape and has a circumference of 11 cm. There are a few cystic areas containing a small amount of serous fluid. Although it extends down to the articular surface, it does not invade the joint except at one place. Neither periosteum, cortex or medullary are affected beyond the point where the tumor tissue probably ends. The contour corresponds to a giant-cell tumor of the benign type. In addition, there was a small nodule in the soft tissues about 2 cm. from the main tumor.

Three portions of the tumor were subjected to microscopical examination, *i.e.*, from the soft parts, from the periphery, and from the central portion. Microscopical examination of all three specimens showed the tumor to be a highly malignant spindle-cell sarcoma, and not a giant-cell tumor. The patient made a good recovery, and is now wearing an artificial limb seven months after the operation.

This case is of special interest as it again emphasizes the difficulty of making a diagnosis of giant-cell sarcoma from the clinical and X-ray findings alone even when supplemented by microscopical examination of a small specimen removed at exploratory operation.

Case XII.—*Benign Giant-cell Sarcoma of the Radius.*—F., female, forty years of age, was admitted to the Hospital for Ruptured and Crippled on November 28, 1919, with a tumor of four months' duration. A microscopical examination was made by Doctor Jeffries, who reported giant-cell sarcoma; this was later confirmed by Doctor Ewing who pronounced it a giant-cell sarcoma. The tumor was a very small endosteal one, and seemed to be a good case in which to test the value of Bloodgood's method of treatment, that is, curettage and carbolic acid; accordingly, no other treatment was employed. Six weeks later, the tumor had recurred and was growing rapidly in size. The patient was put upon systemic injections of the mixed toxins; at the end of six weeks' treatment, the tumor had practically disappeared; and the toxins were discontinued. Three months later, the disease had recurred and was increasing rather rapidly. She was then put upon radium-treatment alone, which was kept

up for four months, a total of 90,000 mc. hours being given. During the treatment there was steady increase in size of the tumor, with no new bone production; the disease now extended 3 inches above the lower end of the radius. An amputation was considered unavoidable, but before resorting to it, it was decided to give her another trial of toxin-treatment. The radium-treatment was discontinued, and the toxins were resumed in October, 1920, and continued for four months. Immediate and steady improvement was noticed, with gradual regeneration of new bone filling up the area that had been destroyed by the tumor. She received no further treatment after February, 1921. A recent examination shows the lower end of the radius to be in excellent condition; there is complete restoration of function; and the patient is in good general condition, four years since the beginning of treatment.

The most striking cure of giant-cell sarcoma that has come under my observation, was a case of sarcoma of the spine and not of the long bones. This case is published in full in my paper in the Transactions of the Third International Congress for Cancer Research, Brussels, 1913.

The following is a brief abstract:

Male, age twenty. Always well until latter part of 1901, when he developed a swelling in mid-dorsal region. The tumor grew rapidly; partial paralysis of the lower extremities began a short time later and he was sent to the Montefiore Home for Incurables. I saw him at this institution in consultation with Dr. V. P. Gibney in February, 1902. At this time he had a very large tumor, occupying at least five or six of the dorsal vertebræ. He had complete paralysis of the bladder and rectum and lower extremities and had lost fifty pounds in weight, and his condition seemed absolutely hopeless. He was put upon the toxins of erysipelas and B. prodigiosus without any other treatment. The treatment was kept up four months with severe reactions. Improvement was immediate and striking. He was able to walk with plaster cast in September. He made a complete recovery and married not many years later, has two children, and is well more than twenty years. Microscopic examination was made at Bellevue Hospital Laboratory. It was pronounced by Dr. Harlow Brooks as round-cell sarcoma and had many giant-cells.

The following four cases while classed as giant-cell sarcoma were all clinically malignant; furthermore, on microscopical examination, three were pronounced malignant by the Mayo Clinic Laboratory, two by Doctor Wood, and three by Doctor Barrie; also, in the first and second cases of this group, at the time of the original exploratory operation, Doctor Ewing said that he did not regard them as belonging to the benign group. In the third case, the tumor had broken through the bony shell and had invaded the soft parts, and in the first three, the knee-joint was extensively involved. In three of the four cases, amputation had been strongly advised by a number of surgeons (in two cases, by myself). The limb was saved in three of these cases, and in the fourth case, the tumor which had apparently disappeared, recurred at the end of six months, necessitating amputation.

CASE XIII.—*Sarcoma of the Lower End of Femur.*—(For full report see ANNALS OF SURGERY, December, 1919).—L. G., female, twenty-one years of age,

with a tumor of the lower end of the femur, with extensive involvement of the knee-joint. Amputation had been advised but refused. A small section was removed for microscopical examination; no curettage.

Pathological report by Doctor Ewing: "The mass consists of several broken portions of tumor tissue, each about 1 cm. in diameter.

"On section the masses are composed of dense fibrous tissue, in many places hyaline, covered with a fringe of sarcomatous tissue of the type of giant-cell sarcoma. The giant cells are of the epulis type. There are a few trabeculæ of bone which are separated by spindle tumor cells and are undergoing absorption. In several places the dense fibrous tissue is infiltrated by strands of tumor tissue in which the cells are spindle in form, with slightly hyperchromatic nuclei, but without admixture of giant cells.

"In the absence of full data regarding the anatomy of the tumor and its clinical course, it is impossible to give any positive opinion of the clinical malignancy of the case. The giant-cell areas belong in a group which generally pursues a benign course. The spindle-cell areas seem to possess greater growth capacity."

Doctor Ewing, later reporting on the case, stated: "The tumor was not histologically benign; I merely mean it was not extremely malignant."

The patient was put upon prolonged toxin-treatment which was kept up for nearly a year. Immediate improvement was noticed which continued until complete recovery had taken place. She is still well nine years later; and has a useful limb, with two inches' shortening.

Another case, almost identical, is:

CASE XIV.—*Sarcoma of the Lower End of the Femur and Upper End of the Tibia.*—(For full report see ANNALS OF SURGERY, December, 1919).—C. S., female, twenty-nine years of age, was admitted to the Memorial Hospital on November 10, 1916. Amputation had been advised by every surgeon who saw the case, including myself, but the patient refused. I did an extensive curettage, keeping the cavity clean with Dakin's fluid. The patient was then put upon the toxins for about three months, followed by one radium-pack treatment and a steel needle of radium (100 mc.) introduced for three hours. The patient made a complete recovery, with complete restoration of function; there is practically no shortening, and she walks with scarcely a limp. It is now seven years since the treatment was begun. She is in good health, January, 1924.

A microscopical examination was made by Doctor Ewing, who reported:

"The tumor has the general features of a giant-cell medullary sarcoma. Several areas are unusually cellular, which indicates a guarded prognosis."

In order to verify the diagnosis, Doctor Ewing made a further examination, and reported:

"While the tumor shows certain areas of typical giant cells, there are other areas in which the giant cells are comparatively few in number and bunches of spindle and round cells are present."

CASE XV.—C. F., female, seventeen years.—Central sarcoma of the upper end of the Tibia, mixed-, giant- and spindle-cell. (For full report see ANNALS OF SURGERY, December, 1919.) Admitted to the Hospital for Ruptured and Crippled in August, 1915. Disease pronounced giant-cell sarcoma of the epulis type, very moderate degree of malignancy by Ewing; malignant by Barrie and MacCarty. Curetting followed by toxins; 7 months later toxins discontinued on account of attack of grippe; recurrence of tumor; second curetting; recurrence;

again treated with toxins and one application of radium (pack). Complete recovery with useful limb; well at present eight years later.

CASE XVI.—*Giant-cell Sarcoma of the Upper End of the Tibia with Involvement of the Entire Knee-joint.*—M. C., female, twenty-three years of age, was admitted to the Hospital for Ruptured and Crippled on December 5, 1920.

Previous history: In July, 1920, the patient fell on a hard floor, injuring her knee; two or three days later severe pain set in, and a short while after, a swelling developed. She remained in bed for two weeks, the pain increasing in severity. She consulted Dr. J. H. T. Sweet of Hartford, Connecticut, who, at first regarded the condition as tuberculosis and applied a plaster cast; but on further clinical and X-ray examination, Doctor Sweet believed the condition to be sarcoma. On December 7, 1920, she was referred to me by Doctor Burlingame of Cheney Brothers (where the patient was employed). Physical examination at this time showed complete destruction of the upper end of the tibia, with involvement of the entire knee-joint; there was marked enlargement of the upper end of the tibia extending down about 4½ inches. Clinical and X-ray diagnosis: central sarcoma, malignant. Extensive curetting was performed under ether, followed by a prolonged course of toxin treatment. The wound was kept clean with Dakin's solution. The operation showed a tumor the size of an orange, occupying the upper end of the tibia, which completely destroyed the cartilage of the knee but which did not involve the femur. The joint was disorganized and filled with fibrous broken-down tissue; the tumor was partly cystic, the solid portions of which, were of a reddish color. The cavity was swabbed out with carbolic acid and packed with sterile gauze; and the limb was put up in a plaster splint. After receiving thirty-nine injections of the mixed toxins at the hospital; the patient returned home, where the injections were continued for two months; no other treatment was given. The cavity filled up with normal granulations and the sinus healed within three months. Microscopical examination:

(1) By Doctor Jeffries:—"Giant-cell sarcoma. The tissues exhibit a considerable degree of necrosis."

(2) By Doctor Ewing:—"Giant-cell sarcoma, epulis type."

(3) By Doctor George Barrie:—"Definitely malignant tumor; fibro-sarcoma."

Clinically the tumor was malignant in view of the rapid growth and destruction of the whole upper end of the tibia with involvement of the knee-joint. The patient did well for about eight months, and then the disease recurred locally. Infection of the wound set in, which was greatly aggravated by one application of radium; and immediate amputation had to be performed. The patient made a good recovery, and is well at the present time, two years after the amputation.

An interesting result in a case of tumor of bone other than a long bone was published in an earlier paper (Transactions of the Third International Conference of Cancer Research, Brussels, 1913), and will be mentioned briefly here:

CASE XVII.—*Giant-cell Sarcoma of the Ilium.*—Mrs. F., thirty years of age. Patient fell on the ice in 1908, receiving a severe blow on the buttock and ilium. A tumor developed two months later. First operation performed by Dr. Andrew J. McCosh at the Presbyterian Hospital. Microscopical examination by the pathologist of the Presbyterian Hospital showed the tumor to be a giant-cell sarcoma. X-ray treatment was given shortly after operation. The tumor recurred

and became inoperable. Radium treatment was begun in June, 1909, by Doctor Abbe, of New York, and continued by Doctor Wickham, of Paris. During 1910, she received several very large doses of radium, without controlling the growth, The patient was referred to me by Dr. Frank Hartley, in May, 1911, at which time she was markedly anæmic and considerably emaciated suffering from intense pain. Physical examination showed a large inoperable tumor of the ilium. Under four months' toxin-treatment, the tumor became very much smaller and broken

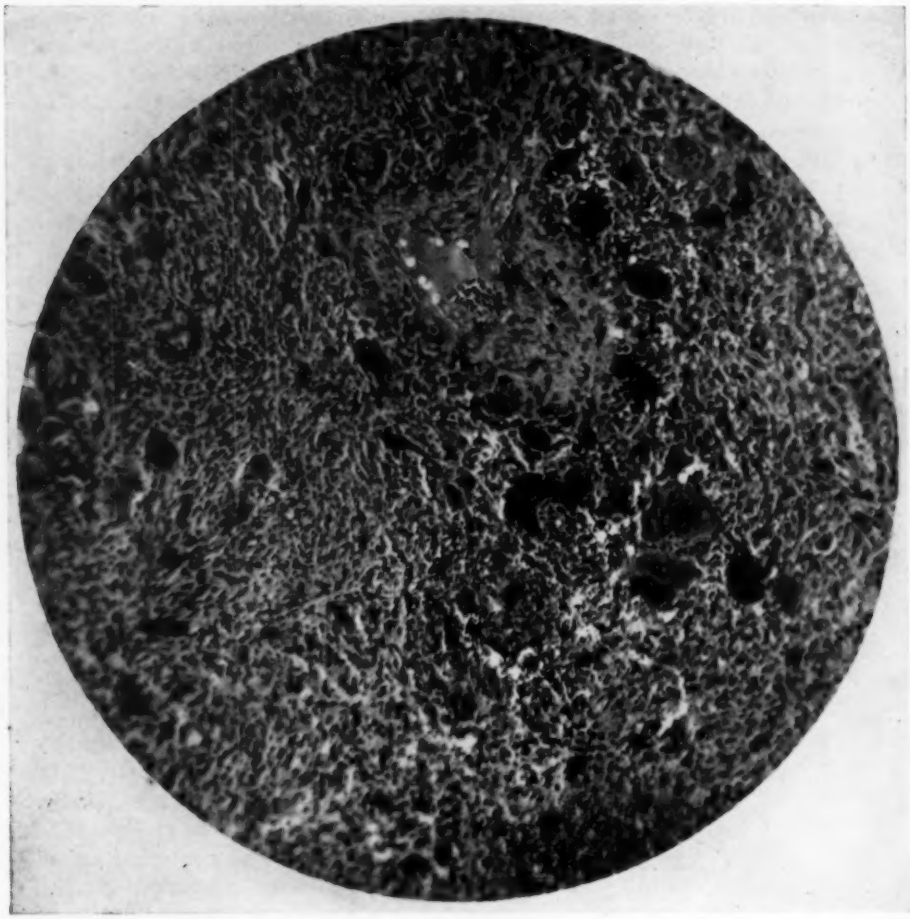

FIG. 44.—Epulis type, recurrent after operation. Not controlled by either toxins or radium. Disease progressing when left hospital, patient not traced.

down, making it advisable to do a curettage. A microscopical examination was made by Doctor Ewing, who reported:

"The tumor, diagnosed as giant-cell sarcoma, proves in my sections of the material to be, as supposed, a giant-cell sarcoma. It is composed chiefly of small spindle cells in which lie many giant cells of the epulis type. There are numerous areas of hemorrhage, and the giant cells are most numerous in these areas. The structure is that of a tumor of moderate malignancy. Its position may render it more serious than if it were in a superficial position, but histologically, it is not to be classed with the more malignant or periosteal growths."

The patient, apparently, made a complete recovery and remained well for five

years, when the disease returned, and she died the following year of symptoms of probable metastases.

Although giant-cell sarcomata of the jaw are usually regarded as benign, I have observed two cases in which the disease progressed with great rapidity and caused death within less than six months. There was no positive evidence of metastases in either case. The microscopic diagnosis was: giant-cell

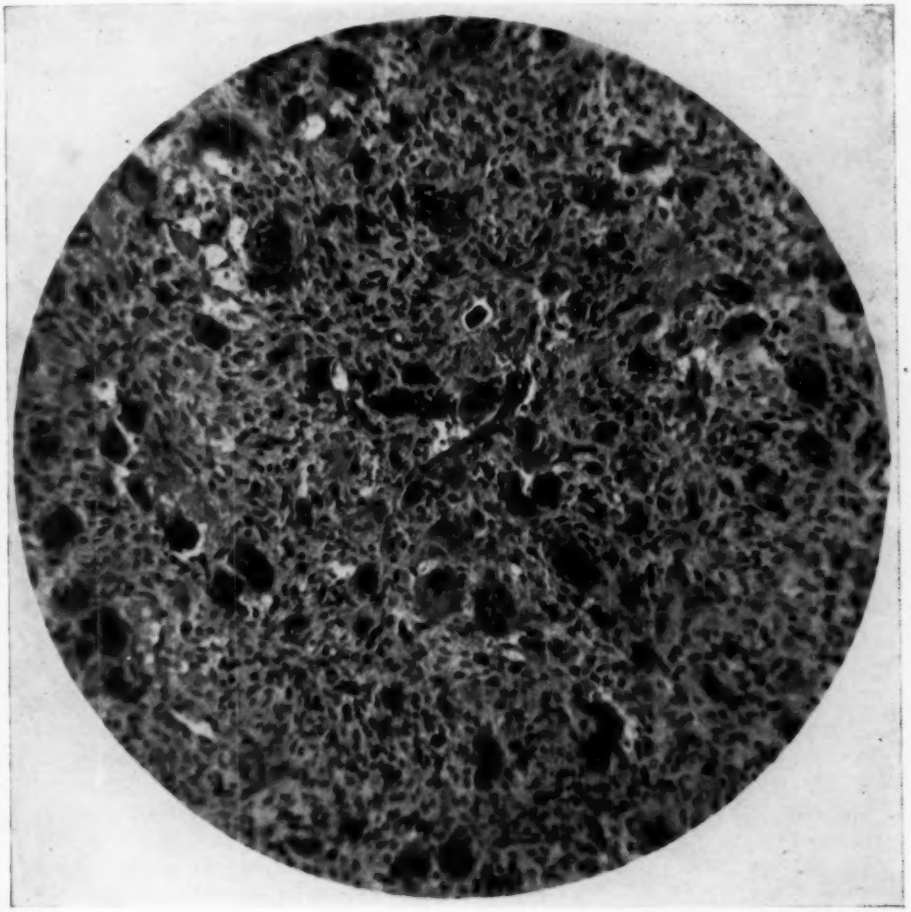

FIG. 45.—Giant-cell sarcoma epulis type. Specimen removed from metastatic tumor of ilium six months after removal of primary tumor of jaw.

sarcoma of the epulis type, in both cases. In one case the diagnosis was made by Doctor Ewing.

The following case was seen by me in consultation with Doctor H. H. M. Lyle, who has kindly given me permission to report it:

CASE XVIII.—*Giant-cell Sarcoma of Lower End of Right Femur.*—M. O., male, thirty-four years old, was admitted to St. Luke's Hospital on April 8, 1921. Seven months before, the patient had been struck on the outer side of the right knee, by a heavy weight, immediately after which, the knee became swollen and

extremely tender. The swelling subsided in two weeks; but the pain continued and remained unvaried in character since the onset; there were no signs of inflammatory trouble present.

Physical examination showed a well-developed, well-nourished man of thirty-four years. General physical examination negative.

Clinical diagnosis: Bone cyst of femur, or giant-cell sarcoma.

Röntgen examination showed an area of diminished density in the lower end of the right femur extending from the articular surface of the external condyle up for a distance of 6 cm. There were lines of density equal to the bone dividing the rarefield areas into sections giving the appearance of osteitis fibrosa cystica. The process extended from the anterior to the posterior surface of the bone. Lungs were free.

Pre-operative diagnosis: Bone cyst of femur.

Post-operative diagnosis: Bone cyst of femur, question of osteosarcoma.

Operation, April 13, 1921: Incision, curettage, and carbolic acid.

Pathological report: "The external condyle of the femur was hollowed out by a large cavity 1½ inches or over in its transverse direction, and one inch from front to back. The wall externally, was of paper-like thinness and anteriorly was also quite thin. The cavity contained a considerable amount of grayish-yellow material mixed with blood, the bone covering very soft."

Microscopical examination: "Sections of the soft parts show that they are composed almost exclusively of a dense fibrous stroma in which many fairly regular giant cells of the epulis type are thickly distributed. The nuclei of these cells are comparatively regular and their morphology is that of one of the more benign types of myeloid sarcoma. The stroma, although very cellular is composed of nuclei also fairly regular, but mitoses are not infrequent. It cannot be considered a benign tumor, although it probably has arisen in the myeloid cavity The older portions of the stroma are less cellular. There is no cartilage, but very early osteoid areas may be found." St. Luke's Hospital Laboratory, Doctor F. C. Wood and Doctor Knox.

Second operation, May 11, 1921: Incision, curettage, muscle transplant.

Pre-operative diagnosis: Giant-cell sarcoma of femur.

Post-operative diagnosis: Giant-cell saroma of femur.

Microscopical examination: "Sections show considerable solid cellular tissue of the spindle-cell type, in some of which giant cells are rare. In other areas they are more frequent, but tend to be small and only have a limited number of nuclei. The cells of the stroma are rather short and rounded, vary considerably in their nuclear chromatin, and mitoses are frequent. Parts of the tumor are hemorrhagic and show old blood pigment. There are a few bony trabeculæ evidently from the normal bone, although a few of them may be newly formed. There is not, however, much tendency toward differentiation. On the whole, the section resembles an earlier one, but the giant-cells are somewhat less frequent."

Röntgen examination August 4, showed an area of rarefaction in the lower end of the femur.

Röntgen examination September 3, showed the rarefied area considerably decreased; and the process, apparently, not active at the present time.

Examination in the beginning of October, 1923, showed the patient well and in good condition, two and one-half years later.

The following three cases, while not personally observed, have been of great interest to me ever since they were published in the *Journal of the Michigan State Medical Society* (October, 1916) by Doctor Harold deB. Barss. Through the courtesy of Doctor Barss, I have been able to keep a

careful follow-up record of these cases, and through the kindness of Doctor Warthin, Pathologist, Surgical Clinic, University of Michigan, I have just been supplied with microscopic slides and micro-photographs of the cases. The fact that they are all well at the present time is of special interest and justifies us in briefly reporting the cases here:

CASE XIX.—*Myelogenous Giant-cell Sarcoma of the Lower End of the Femur; Curettage; Toxins; Recurrence in Four Months; Amputation; Recovery; Patient Well over Eight Years Later.*—M. G., female, eighteen years of age, was admitted to the University Hospital in August, 1915. Symptoms: pain and swelling of lower end of femur; previous local trauma. Duration: six months. X-ray report: "There is an almost exactly spherical shadow about the size of an orange on the lateral aspect of the knee, central, just over the external condyle. It has produced a calcification and absorption of the shaft for about one-half its diameter. The external condyle is almost completely decalcified. There is almost no time reaction, a mere suggestion of calcification along one edge. Diagnosis: Evidently some neoplasm, presumably sarcoma."

FIG. 46.—Clinical and X-ray diagnosis was giant-cell sarcoma; exploratory operation and curettage; microscopical diagnosis; malignant central sarcoma. Operation by Dr. Lilienthal in March, 1922. Curettage and fat implantation: followed by toxin treatment.

Exploratory operation, with curetting. Microscopical diagnosis: "Giant-cell, spindle-cell myelogenous sarcoma. Much necrosis." The mixed toxins of erysipelas and bacillus prodigiosus were begun two days later; a second course was begun one month later; the last injection was given on January 15, 1916. In the middle of January, 1916, a local recurrence developed; rapid growth; hip-joint amputation was performed, microscopical diagnosis; myelogenous giant-cell sarcoma. Microscopical examination of limb after operation showed that the tumor had extended to the surface of the cartilage covering the external condyle of the femur. It had infiltrated the soft parts along the external ligament to the head of the fibula. Of the lower end of the femur internal to the tumor there was but a thin shell of bone which was easily crushed. The tumor extended posteriorly into the soft parts to within one-quarter inch of the popliteal vessels.

The patient made a good recovery. A letter from her family physician on October 13, 1923, states "M. G. is enjoying good health; no symptoms of any return of her former malady; physically and mentally she is normal."

Doctor Warthin on reviewing the microscopic slide, states: "This is a relatively benign type of bone sarcoma; practically no danger of metastasis. Local excision advised by pathologist but because of large size of neoplasm and the amount of bone replaced, hip-joint amputation was performed."

Microscopical Report (Doctor Ewing, December 18, 1923):

"Giant-cell tumor atypical. In places on outer edges, stroma is very cellular. Cells are large spindle, round, or polyhedral. Hyperchromatism slight. Probably benign but prognosis doubtful. Likely to recur after incomplete curettage."

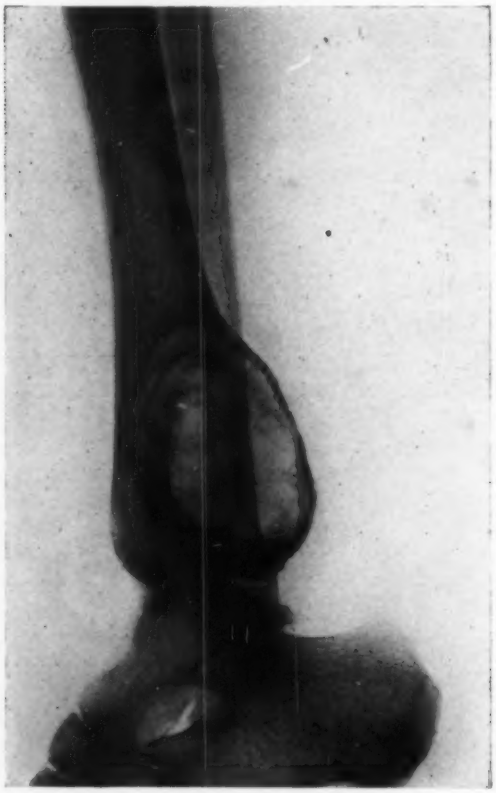

FIG. 47.—Same case two years later; no evidence of return of the disease.

CASE XX.—*Central Sarcoma of the Upper End of the Humerus; Exploratory Operation Followed by Toxins; Complete Recovery; Patient Well Eight Years and Eight Months Later.*—A. W., male, fifteen years of age, was admitted to the University Hospital in January, 1915, with a tumor of the right shoulder; inability to raise arm; pain in right shoulder for eight months; no history of injury.

Radiographic report: "On the external anterior surface of the head of the humerus involving both the epiphysis and the diaphysis, there is an irregular area of absorption with localized areas of calcification on both in the centre and the periphery extending well out toward the integument. The head of the bone is considerably enlarged with practically no wasting of the shaft of the humerus distal to the pathology. Diagnosis: Sarcoma of the head of the humerus." Exploratory operation; microscopical diagnosis: "Myelogenous sarcoma; great numbers of enormous giant cells in a matrix of large round epitheloid cells, probably of endotheloid origin; prognosis not very good; should be searched carefully for metastases." The mixed toxins were begun three days after the operation. The patient was discharged from the hospital in March, 1915, and the toxins were continued at home. Report January 15, 1916; wound healed, patient in good health, and getting use of arm; no pain.

A letter from the family physician on October 12, 1923, states:

"Patient is a fine young giant; works in grist mill, lifting heavy bags, etc.; could not be better."

Doctor Warthin, on reviewing the microscopic slide of this case, states:

"This is a relatively benign type of bone sarcoma but in our experience, more malignant in the scapula than in the long bones. We have seen two cases of this neoplasm primary in the scapula with metastasis."

Microscopical Report (Doctor Ewing, December 18, 1923):

"This appears to be one of the cases of giant-cell tumor associated with the absorption of cartilage. Such tumors are generally found at the head of the humerus. The giant cells are rather numerous, typical epulis type, and most numerous about blood spaces. The accompanying cells are peculiar, and are rather large polyhedral granular cells occurring in sheets, and clumps. In some areas the giant cells are missing and the polyhedral cells appear exclusively. There are several small foci in which there is dark staining fibrillar or partly hyaline material, which appears to be degenerating cartilage. There may be some new formation of this imperfect cartilage. There is no sign of bone formation. It does not resemble any of the well-known forms of osteogenic sarcoma. Tumor is relatively benign, but probably more active than most giant-cell tumors."

CASE XXI.—*Central Giant-cell Sarcoma of the Tibia; Curettage Followed by Toxins; Recovery; Well Eight Years Later.*—T. F., female seventeen years of age, was admitted to the Surgical Clinic on March 1, 1915. Symptoms: pain and swelling in right knee and inability to use the limb for about five months. X-ray report: "The head of the tibia is the seat of a rather absorbing process which has resulted in the loss of all details of the external portion. The joint surface is spared. There is some swelling. No periosteal reaction, no abnormal calcification. The cortex has entirely disappeared both front and back. Evidently and infiltrative growth within the bone. Diagnosis: sarcoma."

Exploratory operation on March 4, 1915; pathological diagnosis: "giant-cell myelogenous sarcoma." The patient was immediately put upon the toxins, the maximum dose being nineteen minims. Rapid improvement took place, as well as gain in weight, and disappearance of pain. A second course of treatment was begun on April 28, 1915, and a third course on August 18, 1915. Examination on November 5, 1915, showed the patient in excellent condition; and the wound practically healed. In February, 1916, a small soft area appeared in the centre of the former incision. Another course of toxins was begun. By April 26, 1916, the wound had entirely healed; and the suspicious area had increased in size. Radiographic picture confirmed fears; the thin sclerosing margin of the surgical defect had almost disappeared; the cortex on the internal surface had reduced considerably; diagnosis; recurrent sarcoma of head of tibia. The patient was advised to continue toxin-treatment.

While this is the latest note found in the published record of the case, a letter from the family physician on December 4, 1920, states:

"This patient, as far as can be observed, is in perfect physical condition. The upper shaft of the tibia, where the osteo-sarcoma, or medullary sarcoma was located, being in healthy and normal condition, never having recurred or given her trouble since recovering from same (this dating from the time she was in your clinic)." Under date of October 13, 1923, the family physician again wrote: "Patient is in fine health, and the end results of operation and treatment are fine; there is no return or any effects left."

Microscopical Report (Doctor Ewing, December 18, 1923):

"Giant-cell tumor; typical benign."

Through the kindness of Dr. W. Edward Gallie, of Toronto, Canada, I am permitted to give a brief history of a case of giant-cell sarcoma of the femur which he recently showed before the Interurban Surgical Society in Toronto. This case is of particular interest, as it is one of the few giant-cell femur cases that have been cured by curettage.

CASE XXII.—Male adult; history of repeated trauma in 1914; in 1920, fell on the ice, causing a severe sprain of knee; he was laid up in bed for two weeks

with swelling and soreness; the latter continued, but the severe pain disappeared after one year. Examination on March 17, 1922 showed patient walking with a slight limp; left knee-joint apparently normal; slight thickening of lower end of femur; deep tenderness on inner side. X-ray diagnosis: Giant-cell tumor.

Operation by Doctor Gallie on April 12, 1922, who made a window in the outer side of the external condyle about 2½ inches long and 1 inch wide; cortex was only ⅛ inch thick. A large cavity was found containing hemorrhagic and yellow

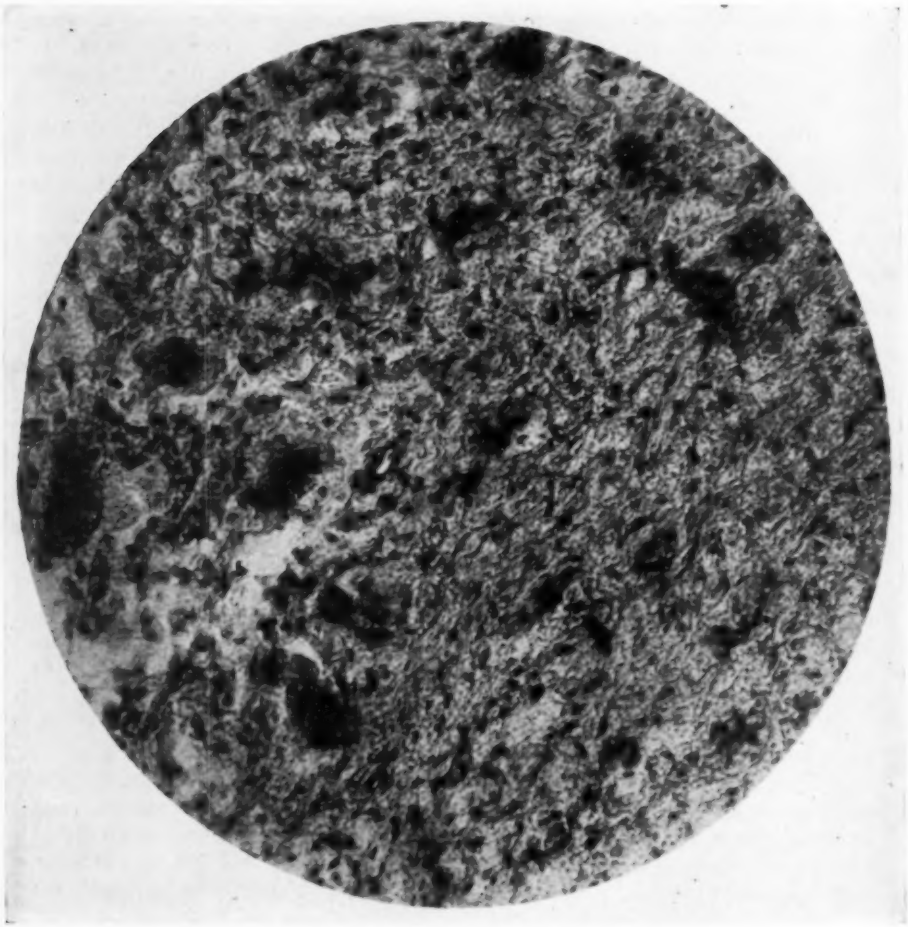

FIG. 48.—(Case No. 19 in femur table.)

tumor mass of a very crumbly nature, in which were many small bony particles. The tissue resembled a mass of fish eggs. The cavity was thoroughly curetted, and filled with pure carbolic acid which was left in for about three or four minutes; after which it was aspirated and filled with pure alcohol. The periosteum was closed over a window. The patient made a good recovery and was still well when last observed one year and eight months later.

As to the pathological examination, Doctor Gallie states: "The tissue was submitted to the pathologists here and the diagnosis of giant-cell tumor confirmed. A section was also sent to Doctor Codman and the diagnosis

confirmed by him. There is just one point about it which does not agree with Doctor Ewing's description of benign giant-cell tumor. It seems to be filled with small spiculæ of bone, which are evidently alive, and I think must be interpreted as evidence of bone proliferation. Doctor Ewing says that these benign giant-cell tumors should not contain new bone."

CONCLUSIONS

In view of the cases here reported, it would seem necessary to modify the opinion so strongly held by most of the leading pathologists of to-day, that giant-cell sarcoma is *always* benign and never gives rise to metastases. As far as the author can see, there is only one explanation of these cases which still leaves it possible for one to entertain the theory that giant-cell tumors are always benign; and that is, to assume that all of the cases here reported, in which metastases developed ending in death, were cases of mistaken diagnosis. It is quite clear that such explanation concedes the whole position. As a matter of fact, however, in the author's personal series of cases, the diagnosis of "benign giant-cell sarcoma" was made not only by competent pathologists, but in many cases by the very pathologists who had made a most careful study of bone tumors; so that if men of such wide experience are unable to differentiate the benign from the malignant type until death from metastases occurs, how much less likely is it that pathologists of ordinary experience will be able to make such differentiation?

We must admit that the treatment of giant-cell sarcoma of the long bones, by radium or X-ray, is at present in an experimental stage, and the results thus far obtained do not warrant us in giving up the standard method of surgical treatment (curettage) with or without the subsequent use of radium or toxins.

The end-results following the different methods of treatment would seem to justify us in regarding the best method of treatment of these giant-cell tumors as follows:

a. Exploratory operation with curettage of all the tumor that it is possible to remove;

b. Swabbing out the cavity with pure carbolic acid and alcohol or zinc chloride;

c. Packing the cavity firmly with gauze to control hemorrhage;

d. Putting up the limb in a circular plaster-of-Paris cast if there is any danger of pathologic fracture;

e. Keeping the cavity clean with Dakin's solution;

f. Systemic treatment with the mixed toxins of erysipelas and bacillus prodigiosus for a period of three or four months supplemented with at least one massive dose of radium in the form of a pack; *e.g.*, 12,000 mc. hours at 10 cm. distance over three areas, if available; if not, X-ray may be used;

g. If the disease recurs in spite of curettage and prophylactic treatment, a second, or even a third curettage may be employed, combined with further

TABLE I.

SYNOPTICAL TABLE OF CASES OF GIANT-CELL SARCOMA.

Radius Cases

Name	Date	Age	Sex	Locality	Duration	Trauma	Clinical diagnosis	Microscopical diagnosis	Treatment	Immediate result	End result
1. L. D'G..... R. & C. Hosp.	1918	29	M.	Lower end	5 mos.	No	Sarcoma broken through bony shell; pathol. fracture	No explor. op.; no mic. ex. X-ray & clinical diagnosis positive	Toxins alone systemic injections	Immediate and rapid improvement complete disappearance; replacement with new bone	Perfect function; well January, 1924, 5¾ years
2. G..... Memorial Hosp.	1922 Sept.	33	M.	Lower		Fall	X-ray diagnosis: Giant-cell sarcoma		X-ray (Dr. Herendeen)	First, slight increase in size; later decrease	Much improved, able to work, January, 1924.
3. M. F..... (Case No. 12 in text). R. & C. & Memorial Hosp.	1919	40	F.	Lower end	5 mos.	No	Central sarcoma, giant-cell X-ray diagnosis	Giant-cell, benign (Ewing)	Curettage and carbolic; recurred; toxins 2 mos. tumor disappeared; recurred; radium 4 mos.	Steady increase in size; toxins again 3 mos.; tumor entirely disappeared; new bone replaced destroyed portion	Well at present, 4 years later; complete restoration of function.
4. C. H..... Seen in consultation	1902	29	F.	Lower end	5 mos.	Yes, severe bruise	Sarcoma	Giant-cell sarcoma	1st curettage, Sept., 1900 2nd curettage, Oct., 1900 Dr. Hibbs	Remained well after 2nd curettage	Examined by Dr. Coley on Nov. 19, 1907; patient well 7 years.
5. M. F..... Memorial Hosp.	1908	26	F.	Lower end	Few weeks	Injury several years	Sarcoma, pathologic fracture	Giant-cell sarcoma (N. Y. Hosp. Lab.)	Curettage, by Dr. Frank Hartley, who advised amputation; this refused; toxins by Dr. Coley	Recovery; fracture reunited; new bone formed	Patient well at present, 15 years later.
6. M. M..... *Seen by Dr. Coley in consultation. Treated by Dr. Bancroft.	1920	30	F.	Lower end	3 yrs.	Yes, fall	Sarcoma, central	Giant-cell sarcoma (N. Y. Hosp. Lab.)	Curettage filling with bone wax, 1917; recurrence 1 yr.; 2nd curettage; radium; X-ray (5 treatments) (Dr. Bancroft)	Severe burn from X-ray Dec., 1919; resection of radium and ulna for osteomyelitis; 4th operation, May 2, 1921	Nov., 1920, 3½ years after 1st op., wrist-joint anchylosed, marked limitation of motion, metacarpal phalangeal articulations. Nov., 1923, partial restoration of function. Able to work.
7. E. W. T..... Seen in consultation	1912	48	M.	Lower end ulna	4 mos.	Yes, strain	Sarcoma central	Giant-cell sarcoma (Bloodgood)	Later operated on by, Dr. Bloodgood; resection, 2 in. of ulna	Recovery	Well 10 years later.
8. F. S..... Memorial Hosp.	1911	25	F.	Lower end radius	6 mos.	No	Central sarcoma	Spindle-cell (mic. ex.), Giant-cell (X-ray diag.)	Exploratory op. by Dr. Haines; tumor not curetted; Toxins alone for 6 wks. (Dr. Coley)	Tumor entirely disappeared; complete restoration of function; new bone	Well 3 yrs. later when last traced.
9. R. R..... Memorial Hosp.	1918	30	M.	Upper end of fibula	2 yrs.		Clinical and X-ray diagnosis: sarcoma	Giant- and spindle-cell	Operation (Drs. Coley and Hoguet); profuse hemorrhage wound fulgurated with Keating-Hart apparatus	3 days later developed gas bacillus gangrene; immediate amputation. Recovery	Later history not traced.

* This case was treated at other hospitals; seen later by Dr. Coley, in consultation. It has been reported by Dr. Bancroft in Clinics of North America, page 1747, Dec., 1921.

TABLE II.

SYNOPTICAL TABLE OF CASES OF GIANT-CELL SARCOMA.

Humerus Cases

Name	Date	Age	Sex	Locality	Duration	Trauma	Clinical diagnosis	Microscopical diagnosis	Treatment	Immediate result	End result
1. S. T. C. (Case No. 4 in text) R. & C. & Memorial Hosp.	1923	40	F.	Upper end	2 mos.	Yes, recent fracture	Central sarcoma	Benign giant-cell sarcoma (Ewing) (Bloodgood)	Exploratory op. May, 1923; toxin treatment 6 wks.; radium pack 3 areas, 36,000 mc.h.	Improved markedly under toxins alone, and later, under radium	2 mos., later tumor slowly began to increase in size. Nov. 7, 1923, has developed metastases in radius. Getting worse Feb. 1, 1924.
2. B. P. Memorial Hosp.	1919	7	F.	Upper end	Few months	Yes, recent fracture	Cyst	Giant-cell sarcoma (Ewing)	Curettage, finding clear fluid, scarcely any tumor tissue	Recurred in 2 mos.; toxins and radium; recovery	Well 4 years; perfect function.
3. H. L. B. (Case No. 1 in text) Memorial Hosp.	1910	10	M.	Upper end	5 wks	Yes, fall; fracture	Central sarcoma malignant	Giant-cell sarcoma epulis type benign (Ewing)	Immediate amputation at shoulder without exploratory operation (Coley)	Recovery; toxins given few weeks after amputation	Developed signs of extensive metastases in lungs 14 mos. later. Died in Aug., 1911, 18 months after.
4. R. F. (Case No. 7 in text) Memorial Hosp.	1911	14	F.	Upper end	Few weeks	No	Periosteal sarcoma	Tumor of mixed type: giant and spindle cells of epulis type (Ewing)	Immediate amputation without exploratory operation (Coley)	Recovery; recurrence in 1 mo.	Local recurrence. Died 3 months after, from probable metastases of lung.
5. C. H. (Case No. 8 in text)	1913	14	M.	Shaft	Few weeks	Yes, recent fracture	Sarcoma suspected	Giant-cell mixed type (Vanderbilt Univ. Laboratory)	Patient referred, by Dr. H. H. Trout, of Roanoke, Va. Fracture repaired by Lane plate. Plate removed in 6 wks., due to infection; exploratory operation; amputation at shoulder	Recovery. 1 year later developed metastatic tumor in femur and ilium	General condition grew worse; died of multiple metastases.
6. P. E. Memorial Hosp.	1920	6	F.	Upper third	Few weeks	Yes, fall	Giant-cell sarcoma. X-ray diag.: or cyst	No microscopical examination	X-ray treatment 6 mos., by Dr. Herendeen	Pathologic fracture developed later; re-united	Doing well when last traced 1 year later.

TABLE III.

SYNOPTICAL TABLE OF CASES OF GIANT-CELL SARCOMA.

Tibia Cases

Name	Date	Age	Sex	Locality	Duration	Trauma	Clinical diagnosis	Microscopical diagnosis	Treatment	Immediate result	End result
1. K. K. V. ..... R. & C. & Memorial Hosp.	1904	17	F.	Lower third	11 mos.	No	Sarcoma	Giant-cell sarcoma	Curettage, Oct. 1904; 2nd curettage, Jan., 1905—8 oz. of "reddish-brown" tumor. Op., prolonged toxin treatment, X-rays	New bone formed with complete restoration of function	Patient in good health at present 19 years later.
2. C. F. ..... R. & C. Hosp. (See ANNALS OF SURGERY, Dec., 1919) (Case No. 15 in text)	1915	17	F.	Upper end	6 mos.	No	Sarcoma, central	Giant-cell (Ewing) Fibro-sarcoma (Barrie)	Curettage and toxins	Recurred in 4 mos.; 2nd curettage; recurrence; toxins and radium	Recovery; well at present, 8 years later.
3. J. N. ..... (Case No. 2 in text) Memorial Hosp.	1919	21	M.	Upper end			Central sarcoma	Giant-cell sarc. epulis type, benign (Ewing, Bloodgood, Mallory, Wolbach); Osteo-sarcoma with giant cells (Knox, Wood)	Curettage; radium (bare tubes placed in cavity 2 wks. later)	Did well for 7 mos.; recurrence; 2nd curettage; infection; amputation	Extensive metastases in both lungs 4 mos. later Died.
4. J. K. ..... Memorial Hosp.	1914	30	F.	Upper end	11 mos.	No	Central sarcoma	Giant-cell (Ewing)	Curettage	Not traced beyond 4 months	Not traced.
5. M. G. ..... Memorial Hosp.	1922	35	F.	Upper end	10 mos.	Yes, fall	Central sarcoma X-ray diag.: giant-cell	No microscopic ex.	X-ray treatment at Memorial Hosp. from June, 1922 to Oct., 1923, by Dr. Herendeen	Tumor increased slowly in size but X-ray showed increased density due to deposit of calcium salts	Under treatment Oct., 1923.
6. D. S. ..... (Case No. 6 in text)	1914	14	M.	Upper end	2 mos.	Yes, fall	Sarcoma	Giant-cell sarcoma	Amputation, by Dr. Lucid of Syracuse, N. Y. Aug., 1913, 2 mos. after first noticed	Recovery; remained well until Oct., 1914, then developed typical central sarcoma of radius	Dec., 1914: tumor involv. lower 3 inches radius; bony shell broken thro'; ulna involved. Toxins used temp. improv. Death, July, 1915 metastases in pleura.

7. J. S..... (Case No. 3 in text) Memorial Hosp.	1921	44	F.	Upper end	5 mos.	No	Central sarcoma	Giant-cell of epulis type: (N. Y. Hosp. and Presby. Hosp. Lab., and Dr. Ewing)	Curettage and radium (bare tubes, silver tubes, pack) for 10 mos.	Disease held in check but not controlled. Amputation Oct. 26, 1921, at Presbyterian Hospital	Local recurrence; metastases; death a few months later.
8. M. C..... (Case No. 16 in text) R. & C. Hosp.	1920	20	F.	Upper end	4 mos.	Yes, fall	Central sarcoma malignant; involving knee-joint	Giant-cell sarcoma (Ewing)	Curettage; toxins (Dr. Coley)	Recovery; well 6 mos.; recurred, rapid growth; 2nd curettage; infection; amputation	Well at present, nearly 3 years.
9. C. Rogers.....	1910	16	F.	Upper end	Pain 7 mos.	No		Round- and giant-cell sarcoma	Curettage by, Dr. Steinhardt; toxins after operation (Dr. Coley)	Recovery	Well 12 years.
10. P. H..... Memorial Hosp.	1918	62	M.	Upper end	4 mos.	No	Sarcoma	Giant-cell epulis type (Ewing)	Curettage (small endosteal tumor)	1 radium-pack treatment (12,200 mc. hrs.) by, Dr. Stone	Patient well 5 years later.
11. S. B..... Memorial Hosp.	1918	23	M.	Upper end	Few months	?	Sarcoma	Giant- and spindle cell sarcoma, giant cells, epulis type	Curettage, N. H. Hosp., Apl., 1918; bone wax in cavity. Radium treatment at Memorial Hospital	Unable to trace case since discharged from hospital	Not traced.
12. T. Mcg..... R. & C. Hosp.	1895	13	M.	Upper end	2 wks.	Fall, 2 mos. before	Tumor of tibia	Giant-cell sarcoma	Curettage Dec., 1895; 2 mos. later, rapidly-growing recurrence; amputation, Apl., 1896 (Dr. Coley)	Recovery	Not traced.
13. B. P..... Memorial Hosp.	1909	9	F.	Upper end	1½ yrs.	?	Central sarcoma	Giant-cell sarcoma (LeConte, Chicago)	Primary amputation by Dr. Charles A. Parker, Chicago	Recovery. Prophylactic toxin-treatment advised by, Dr. Coley, but not given	Patient well several years later.

TABLE IV.

SYNOPTICAL TABLE OF CASES OF GIANT-CELL SARCOMA.

Femur Cases No. 1

Name	Date	Age	Sex	Locality	Duration	Trauma	Clinical diagnosis	Microscopical diagnosis	Treatment	Immediate result	End result
1. R. L..... Montefiore Hosp. for Incurables	1898	19	F.	Upper third	Few months	Recent fracture	Central sarcoma, inoperable pathologic frac.	Giant-cell sarcoma Prof. T. M. Prudden	1. Mixed toxins of erysipelas and bacillus prodigiosus. 2. Injections, sodium arsenate. 3. Curettage (Dr. John Rogers)	Slow recovery, re-union of pathologic fracture	Well 8 years later with useful limb.
2. Case of Dr. Winter (Case No. 9 in text).	1908	14	M.	Lower end	5 mos.	Shortly before	Inoperable when first seen, 5 mos. from beginning	Giant-cell sarcoma	Toxins, 21 doses	Decrease in size in 1 mo.; later tumor increased in size	Died 2 mos. later; tumor very large; probable metastases in iliac glands.
3. C. C. S..... Seen in consultation with Dr. Lewis S. Pilcher.	1905	42	M.	Lower end	18 mos.	Sprain	Sarcoma, probably malignant	Typical giant-cell with very little stroma. N. Y. Hosp. Lab.	Amputation advised but refused; curettage	Slow recovery	Patient well 2 years later when last traced.
4. E. R..... (Case No. 5 in text).	1906	16	F.	Lower third	3 mos.	No	Central sarcoma malignant	Giant-cell sarcoma	Toxins 1 mo.; slight improvement at first; amputation followed by 32 doses of toxins	Good recovery	Remained well for nearly 3 yrs., then died of metastases in pelvic bones, and probably, in lungs.
5. C..... R. & C. & Memorial Hosp.	1908	55	F.	Upper third	Fractured hip 5 yrs. before; 2nd inj. 3 yrs. ago	Fall, 5 yr. Fall, 3 yr.	Sarcoma	Giant- and spindle-cell sarcoma	Toxins, few doses, no effect	Tumor increasing in size	Not traced.
6. M. O..... Seen in consultation by Dr. Coley. Case of Dr. Lyle. Case No. 18 in text.	1921	34	M.	Lower end	7 mos.	Struck by heavy weight	Bone cyst or giant-cell sarcoma	Myeloid sarcoma giant-cell	1. Curettage, carbolic acid 2. Curettage, muscle implant	Good recovery	Well 2½ years later.
7. L. G..... (Case No. 13 in text). R. & C. & Memorial Hosp.	1914	21	F.	Lower third	8 mos.	No	Central sarcoma malignant	Giant- and spindle-cell sarcoma (Ewing)	Exploratory op. for diagnosis; no curetting; knee-joint involved. Toxins for nearly 1 year	Immediate and continual improvement; complete recovery; 2½ inches shortening	Well 9 years later.

8. C. S..... (Case No. 14 in text) Memorial Hosp.	1916	29	F.	Lower third involving knee-joint and tibia	7 mos.	No	Central sarcoma malignant	Giant- and spindle-cell sarcoma (Ewing)	Amputation advised but refused; curetting followed by toxin for 2 mos.; 1 steel needle and radium pack	Complete recovery with full restoration of function	Well 7 years later.
9. A. J. McC.... Memorial Hosp.	1911	41	M.	Lower third	4 mos.	Fall	Central sarcoma	Giant-cell sarcoma (Mass. Gen. Hosp. Lab.)	Curettage, with bismuth paste; April, 1910 (Dr. Scudder). Toxins few doses after op.; Jan., 1911 toxins given 6 mos. (Dr. Coley)	Growth checked; old sinus never healed. Jan., 1912, severe infection made amputation necessary. Recovery	Died 1¼ years later of nephritis.
10. C. H. S..... Dr. Bull's Private Hosp.	1911	47	M.	Lower third	1 yr.	Repeated injuries	Central sarcoma	Giant- and spindle-cell sarcoma (Ewing)	Mixed toxins for 1 yr. Disease controlled	1 yr. later, injury, popoliteal artery; amputation	Well 10 years.
11. R. S..... R. & C. Hosp.	1918	17	F.	Lower end	6 wks.	Fall, 4 wks. before	Central sarcoma	Giant-cell sarcoma (Ewing)	Curettage; toxins	Became infected 1 mo. later amputation	Well 5½ years later.
12. L. R..... Memorial Hosp.	1920	40	M.	Lower end		Yes, severe blow	Central sarcoma	Giant-cell sarcoma, epulis type (Ewing)	Curettage followed by radium treatment 1¼ years	Recovery	Well 3 years later; Dec., 1923, fracture of femur just above old tumor, following fall.
13. R. S..... Memorial Hosp.	1922	22	F.	Lower third	10 mos.	Yes	Central sarcoma giant-cell (X-ray diag.)	No mic. ex.	X-ray treatment	Disease nearly stationary	1 year later, little change.
14. L. B..... Memorial Hosp.	1921	50	M.	Lower end	3 mos.	Yes, blow	Central sarcoma	Giant-cell epulis type (Ewing)	Curettage, X-ray, radium (7000 mc. hr. over period of 1 yr.)	Recovery; 1 yr. ago developed ulceration from radium burn; atrophy and fibrosis of soft parts of lower shaft; very severe pain; Amputation, Oct., 1923	Disappearance of pain. Died Feb. 10, 1924.

TABLE V.

SYNOPTICAL TABLE OF CASES OF GIANT-CELL SARCOMA.

Giant-cell Femur Cases No. 2

Name	Date	Age	Sex	Locality	Duration	Trauma	Clinical diagnosis	Microscopical diagnosis	Treatment	Immediate result	End result
15. G. M..... Memorial Hosp.	1922	26	M.	Lower end	1 yr.	Yes, recent fracture	Central sarcoma (X-ray and clinical diag.)	No mic. ex.	Radium, March, 1922, at Memorial Hosp.	Improvement at first; later increase in size. 7, 16, 23 mp. evidence of extension of process	Under treatment.
16. L. D..... Memorial Hosp.	1921	26	M.	Lower end	?	?	Central sarcoma	Giant-cell tumor not malignant (Ewing)	Radium	Improvement	Not traced.
17. S. S..... (Case No. 10 in text)	1916	19	M.	Lower third	1 yr.	Yes, kick	Central sarcoma	Giant-cell sarcoma (Summers)	Local operation; then amputation (Hartwell) Oct., 1915	Did well for 11 mos. then developed metastases in iliac glands and lung	Died. NOTE: For full report see text.
18. I. F..... Memorial Hosp.	May 1923	57	F.	Upper third	8 mos.	No	Central sarcoma	Giant-cell sarcoma (X-ray diagnosis)	X-ray treatment by, Dr. Herendeen	Improvement	Under treatment.
19. R..... Memorial Hosp.	May 1923	25	M.	Lower third	Few months	Yes	Central sarcoma one condyle	Benign giant-cell sarcoma (Ewing)	X-ray treatment by, Dr. Herendeen	Improving	Under treatment, Jan. 1924.
20. T. R..... Memorial Hosp.	1900	28	F.	Lower third	Few months	?	Central sarcoma	Giant-cell sarcoma (Bender Laboratory, Albany)	Amputation (Dr. A. Vander Veer)	Recovery	Examined by, Dr. Coley, 20 yrs. after op.; in good health. Slide of tumor also examined.
21. T..... Memorial Hosp.	1914	50	M.	Lower third		Yes	Central sarcoma	Giant-cell sarcoma	Amputation (Chatham Hosp., Ontario, Canada); toxins after amp.	Recovery	In good health 6 years later.
22. S..... (Case No. 11 in text) Memorial Hosp.	1923	Ad	F.	Lower third	Pain few months	No	Giant-cell sarcoma. X-ray diag.; Giant-cell sarc. Mic. exam. after exploratory operation	After amputation: "Highly malignant spindle-cell sarcoma"	Ex. op. at Flower Hosp. Radium and X-ray treat. at another hosp. 2 casts applied at Ruptured and Crippled Hosp. Amputation at Memorial Hospital	Recovery	Well 7 months later.

use of either toxins or radium. If at the end of six months the disease is still progressing, resection or amputation may be indicated;

h. Primary amputation should very rarely be performed in any type of central giant-cell sarcoma without a prolonged preliminary trial of conservative treatment.

i. Clinical evidence of malignancy; rapid growth, breaking through the bony shell should outweigh the histological evidence of a benign giant-cell tumor, and in cases of this type, amputation should be performed after a brief trial of conservative treatment, if the disease is not controlled.

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TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held December 3, 1923

The President, Dr. John H. Jopson, in the Chair

CONDYLAR FRACTURE OF THE HUMERUS

Dr. E. G. Alexander presented a boy, four years of age, who was admitted to St. Christopher's Hospital, September 17, 1923, with an injury of the lower end of the left humerus sustained as the result of a fall downstairs. Examination showed a supracondylar fracture with forward and inward displacement of the upper fragment (see Fig. 1). Three attempts at bloodless reduction under ether having failed to improve the position, on September 26th, the fracture area was opened by a three-inch long incision on the inferior anterior surface of the arm over the lower end of the upper fragment and open reduction attempted; a great deal of difficulty was encountered on account of the cartilaginous nature of the lower fragment. No internal fixation apparatus or suture was used. The upper fragment was freed of the soft tissue and pushed backward and inward in apposition to the lower fragment. The wound was then closed and the forearm placed in acute flexion. The X-ray (Fig. 2) showed almost perfect reduction. At the end of three weeks the patient was discharged and referred to the dispensary for further treatment. Wound completely healed.

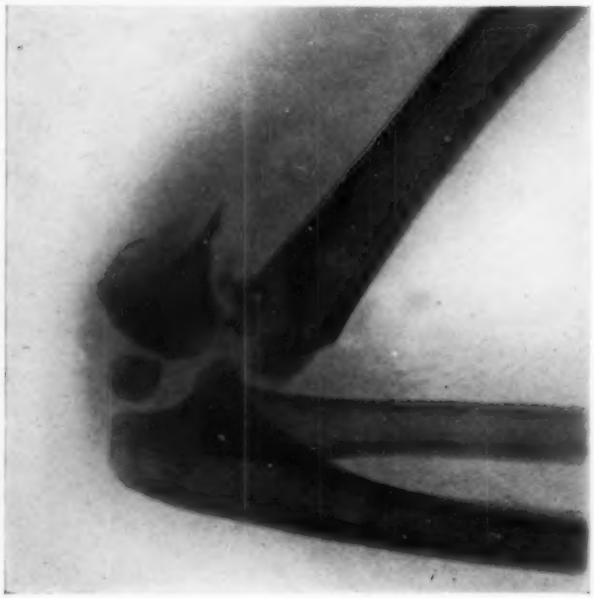

Fig. 1.—Supracondylar fracture of the humerus, before reduction. Case I.

The reporter thought this fracture to be of interest on account of the unusual deformity and the great difficulty of reduction. The patient would probably have gotten a fair functional result if the fracture had been left alone. It is hard, at this age, if the fracture had not been

reduced, to really say how much deformity would have resulted. The "gun-stock" deformity and the loss of the carrying angle are the two possibilities. He was surprised at operation to find no callus, although the fracture was twelve days old.

The case is not a supracondylar fracture. It could be classed as a condylar fracture or as an epiphyseal separation. The condyles were fractured, but the portion between the condyles was smooth, as if it was an epiphyseal separation. It is too soon to record the end result.

FIG. 2.—Case I, after reduction.

FIG. 3.—Supracondylar fracture of the humerus, before reduction. Case II.

DOCTOR ALEXANDER presented a second case of fracture at the lower end of the humerus, in the person of a boy, age eight years, who was admitted to the Episcopal Hospital, October 13, 1923, with the diagnosis of supracondylar fracture of the right humerus. On the day before admission he fell off a fence. He thinks he fell directly on the right arm, with the arm in the outstretched position. There was present about the

elbow a large amount of swelling with discoloration of the soft parts; there is an abrasion of the skin immediately above the internal condyle of the humerus; localized pain, mobility, ecchymosis, swelling, deformity, loss of function and crepitus over the supracondylar region of the right humerus. X-ray (Fig. 3) showed a fracture through the condyles of the right humerus with displacement backward for the entire diameter of the shaft of the lower fragment. It is also displaced outward for one-third of the diameter of the shaft in the antero-posterior view. Attempts at reduction without anæsthesia were unsuccessful.

FIG. 4.—Case II, after reduction.

October 20th, under ether anæsthesia, reduction was accomplished by forcible hyperextension of the forearm and then bringing the arm up in acute flexion. "X-ray (Fig. 4) shows fracture almost completely reduced." Patient discharged from the hospital and referred to the surgical dispensary for further treatment.

This case was shown along with the preceding case to emphasize the fact that in eight days after a fracture of the lower end of the humerus in a child, sufficient callus was not present to interfere with reduction.

PARTIAL RUPTURE OF THE INTESTINE

DOCTOR ALEXANDER presented a boy, aged eleven years, who was admitted to the Episcopal Hospital, October 6, 1923, with the history that about three hours before admission he was roller skating on the street and fell, striking his abdomen on the pavement. He has since vomited seven or eight times, but has not vomited blood. He has pain in the lower left quadrant of the abdomen, is unable to void urine, complains of thirst and is very restless. The child was a rather pale, thin, young male, of about eleven years of age, complaining of pain in the lower part of the abdomen, but apparently not of a serious nature. No symptoms externally. The abdomen was slightly scaphoid in type, no abrasions or ecchymosis, no masses palpable, no dulness in the flanks. On palpation over the lower left quadrant of the abdomen there is superficial tenderness and rigidity present. There was no peristalsis in this area.

Under ether anæsthesia the abdomen was opened through a left rectus incision. On opening the peritoneum a milky fluid was encountered; this was cultured. The intestines were then examined, and in the lower ileum a partial rupture of the wall of the gut was found, which extended through the peritoneal and muscular coats down to the mucous membrane. The rent in the intestinal coats was closed, a rubber tube was placed in the pelvis and the wound closed. The rubber tube was removed the day following operation as the culture showed no growth. The patient made an uneventful recovery and was discharged from the hospital on October 23, 1923.

This case emphasizes the fact that serious intra-abdominal injury may take place without any visible external signs, as abrasions, ecchymosis, etc. It also emphasizes the fact that in all abdominal injuries localized pain and rigidity and the absence of peristalsis warrants one in opening the abdomen.

GUNSHOT WOUND OF THE ABDOMEN

Doctor Alexander presented a lad aged sixteen years, who was admitted October 5, 1923, with the history that shortly before, while he was unloading a 25-calibre automatic pistol, it was accidentally discharged, the bullet entering his anterior abdominal wall and coming out of his back. When admitted he was markedly shocked. Temperature 98. Pulse 144. Respirations 30. Pulse volume low. Immediately below and slightly to the right of the umbilicus in the abdominal wall was a small puncture wound, black in color, with inverted edges, from which a small amount of blood was oozing. In the back, on the left side, slightly below the level of the umbilicus, was the wound of exit of the bullet; a considerable ooze also coming from this wound. The abdominal muscles were rigid, there was dulness in each flank and no peristalsis to be heard. Without delay the abdomen was opened by a right rectus incision. On opening the peritoneum a large amount of fluid blood gushed forth. The intestines were carefully examined for perforations and none found. Clots were found in the omentum and a large hæmatoma could be seen behind the posterior peritoneum in the pancreatic region. The bullet hole could easily be seen in the anterior parietal peritoneum, but no opening could be found in the posterior peritoneum. The abdominal cavity was sponged free of blood, possibly a litre of salt solution poured in, and the wound then closed without drainage. The patient was immediately transfused by the citrate method and anti-tetanic serum given. Recovery was uneventful and the patient was discharged from the hospital on November 24, 1923, in good condition.

THROMBO-ANGEITIS OBLITERANS

Doctor Alexander presented a man, aged fifty-three years, who was admitted to the Episcopal Hospital, April 2, 1923, on account of gangrene of toes due to thrombo-angeitis obliterans. Seven years ago gangrene developed in the left foot and his left leg was amputated at the Samaritan Hospital. His present illness began as a soreness in the toes twenty-one weeks before admission to the hospital. Had been at home in bed for nineteen weeks under the care of his family physician. Has

a feeling of numbness in the toes and suffers a great deal of pain, especially if the foot is exposed to heat.

When admitted he appeared a fairly well developed adult white male, whose left leg had been amputated about four inches below the knee. The great toe, index and middle toes of the right foot are now blue in color and cold; an ulcer is present on the under inner aspect of the great toe; the other toes are slightly discolored. Pulsation in the posterior tibial and dorsalis pedis faintly felt. Blood sugar and urea normal, urine negative.

The patient was kept in bed with the foot elevated, heat was applied and he was given potassium iodide internally. He suffered a great deal of pain and for this intravenous injections of sodium citrate were given without any beneficial result. Morphine was frequently given to relieve the pain.

April 19, 1923, peri-arterial sympathectomy was performed. Following the operation the pain was greatly relieved for a few days. However, the gangrene in the toes became steadily worse and on May 10, 1923, the first and second toes were amputated. Following the operation the patient continued to have pain in the toes and foot, and occasionally complained of pain in the sympathectomy wound. The gangrene continued to progress until on June 11, 1923, a Chopart's amputation was performed. On account of the devitalized and infected nature of the foot, the wound was left open. Following the operation the remaining part of the foot and lower third of the leg became very much swollen, red and tender. This area was opened and drained of the pus which was found above the ankle. The patient rapidly began to improve, all his pain entirely disappeared, and the wounds began to clear up. The wounds finally entirely healed and the patient was discharged from the hospital in good condition.

The arterial sympathectomy had had no effect on the gangrene of the toes, which, when the operation was performed, was becoming steadily worse. The pain was greatly relieved immediately following the operation; it recurred, however, in a few days, but never to be quite as severe as it was previous to the sympathectomy. The pain following the operation seemed to be more intermittent in character, the patient often going several days without complaining sufficiently to require a narcotic. Sodium citrate intravenously for the relief of pain in arterial disease seems, in his experience, to be a most unreliable and overrated measure.

Dr. Astley P. C. Ashhurst, who had seen the first case with Doctor Alexander, said that when he found it had been nine days since the child was hurt, he was dubious as to whether or not he could reduce the fracture after so long an interval. Although he pulled as hard as he could, did not secure reduction. However, he thought that if the elbow was left alone, the child probably would get as good a result as if an open reduction were done, and for the following reasons: First, the child already had complete flexion of the elbow; second, the lower fragment, though posterior, was more

external than internal, so that the development of cubitus varus was not to be feared; third, the fact of the child's extreme youth was in favor of the spontaneous architectural rearrangement of the bone fragments, so that ultimately a reasonably good result would be assured. On the other hand, open reduction at a stage after the injury when so much new subperiosteal bone has already formed, has usually resulted in a stiff elbow in the cases he had seen treated by other surgeons by operation. He had never himself had occasion to operate on so young a child. He thought that Doctor Alexander's second patient showed how useless it is to put the elbow into hyperflexion until reduction is secured. To secure reduction one has only to reverse the process by which the fracture occurred, namely, hyperextension, longitudinal traction, and eventual complete flexion, which he called hyperflexion. When the elbow is flexed it is very important not to flex it in any other than the sagittal plane. If it is flexed up and toward the chest a cubitus valgus will be present when the patient gets well. If it is flexed too much away from the chest, one will get cubitus varus. When flexed one can do what one will with the forearm because the lower fragment is locked on the shaft of the humerus, and the whole extremity—the forearm, elbow, and upper arm—move as one piece. One need not fear rotating the fully flexed elbow in toward the chest, because if the elbow is kept in hyperflexion it is immaterial what is done to the shoulder joint, where alone rotation will occur.

To maintain the elbow in hyperflexion, no dressing is so simple as a roller bandage. First powder the crease of the flexed elbow, and place a small sweat pad in it. Begin with a number of turns of the roller bandage around the wrist, and include the hand in the bandage. Then return to the wrist and again take a number of turns of the roller around the wrist, before carrying the bandage across to the arm below the axilla. Neglect of the precaution to put enough turns around the wrist to make a firm pad of bandage here, may cause the bandage to produce a slough over the subcutaneous border of the ulna, when the roller is drawn taut from this point across to the arm just below the axilla. Then carry the roller back and forth from arm to forearm, bandaging in the elbow much as one would an amputation stump. Finally, carry the same continuous bandage around the child's neck, suspending the wrist from the neck. In all cases the hand, at least its thumb, should lie on the same side of the neck as the injured elbow. If the hand lies on the other side of the neck, the elbow has not been flexed acutely enough to prevent displacement of the lower fragment.

Dr. John H. Jopson spoke of the possibility of Volkman's contracture following treatment of fracture of the elbow by acute flexion. In the early stages, he would hesitate to use forced flexion to the degree recommended by Doctor Ashhurst. He was satisfied to adopt a position of moderate flexion, after reduction under anæsthesia, and later raise the hand to the higher level. He had been well satisfied with the results thus obtained.

Dr. Henry P. Brown said that he expected to show at the next meeting a Russian Jew, thirty-six years of age, who showed evidence of endarteritis obliterans in both feet. Doctor LeConte performed a sympathectomy on the right side with immediate relief of the pain. He did so well, Doctor LeConte wanted him to have the operation done on the left side, but he would not submit. Seven or eight months later the left side became so much worse that he was very anxious to have the operation done. At the time of operation on the left side the contraction of the femoral artery which always follows this operation was just sufficient to shut off the blood supply to the foot and the man had subsequent gangrene and the foot was removed at the end of two or three weeks. Pain was relieved at time of operation. The right side did very nicely. No pain at all. At present he walks around on crutches.

Dr. A. E. Billings said that at the Jefferson College Hospital they had had a number of cases of sympathectomy. All had been relieved from pain with the exception of two, which came to amputation for gangrene. One patient with beginning gangrene of the great toe was finally relieved from pain and it is now one and one-half years since the operation. He is still entirely comfortable and goes to work. Another case operated on one and one-half to two years ago is well. Two patients have come to amputation since and the other day he amputated the leg of a patient whom Doctor LeConte had operated on nine months ago with relief only for a short time.

Dr. George P. Muller had performed sympathectomy eight times for Buerger's Disease, without very satisfactory results from the standpoint of recovery from cyanosis or threatened gangrene. The exception was a patient past middle age who had beginning gangrene of the little toe; after sympathectomy he made a wonderful anatomical recovery and has remained well since, about two years. In three of the cases there was distinct relief from pain and in the other four there was no improvement. They went on to amputation. Leriche's theory is that it relieves vasomotor constriction and improves the blood supply. All of these patients were neurotic, and were mostly Russian Jews. The trouble with patients with Buerger's disease is that in addition to the neurosis they also have thrombosis, and the vessels are almost obliterated. Therefore you cannot get vasodilatation of the vessel. You can relieve the pain by cutting the afferent. Buerger says the thrombosis does not extend to the capillaries but involves the larger vessels, and the hope of sympathectomy is that you can improve the capillary circulation. Kroh shows that while the capillaries may not have muscle walls, yet they have cells which expand under stimulus. The speaker's results had been disappointing in senile and diabetic gangrene.

DUPLEX KIDNEY WITH PYONEPHROSIS

Dr. Leon Herman presented a post-mortem specimen showing pyonephrosis affecting the lower half of a duplex kidney. The individual, a woman of seventy years of age, from whom this kidney was removed,

came to the Methodist Hospital in 1921, with symptoms suggestive of acute left-sided pyelitis. The cystoscopic examination revealed duplicity of the left ureter with infection of the lower pelvic segment. The condition seemed to be a chronic one with an acute exacerbation of the infection. A pyelographic and differential functional study showed a relatively normal upper segment with an infected and functionless lower segment. The patient had diabetes, and after due deliberation it was deemed inadvisable to attempt operation, although the findings suggested the possibility of doing a hemi-resection of the kidney. They were able to keep the infection under control by pelvic lavage, but for a long time the patient absented herself from the clinic. Several weeks ago she was admitted to the medical service of Dr. George Norris in the Pennsylvania Hospital with a very severe attack of renal infection, together with other complications which have now proved fatal. Drainage of the pyonephrosis by means of the ureteral catheter and pelvic lavage were of no avail for reasons that became evident at the post-mortem table. The pyonephrotic sac had ruptured, or at least the infection had spread beyond the limits of the sac, and there was purulent infiltration of the psoas muscle, and a massive left-sided empyema.

There was incomplete duplicity of the right ureter, but neither segment of this kidney had become infected.

TEMPORO-MANDIBULAR ARTHROPLASTY

Dr. George M. Dorrance read a paper with the above title, for which see page 485.

POST-OPERATIVE PULMONARY COMPLICATIONS

The annual oration in surgery was delivered by Dr. Walter Estell Lee, with the above title. For this address, see page 506. Doctor Lee also reported the following case:

The patient was a lad, sixteen years of age, who was admitted to the Germantown Hospital, March 12, 1923, with acute appendicitis and operated upon the same day by Doctors Murray and Bloomhart. The swollen, partially necrotic appendix was removed. He left the table in very good condition on the third day, post-operative, having been fairly comfortable, up to that time he began to complain of pain in the right anterior chest.

Examination at this time of the anterior chest showed a peculiar ringing but dull note upon percussion from the level of about the second rib downward, extending to the side to axillary line, but did not seem so much in evidence here. Posteriorly the patient was not examined. By auscultation over the designated area in the anterior chest, the whispered voice was diminished and in the upper part numerous moist, coarse râles could be heard. Tactile fremitus seemed but little diminished. At this time the apex beat of the heart could neither be seen nor felt to the left of the sternum. There was a visible pulsation synchronous with the heart beat, placed about one inch to the right of the right border of the sternum and in the fourth interspace. The heart sounds

were transmitted over the entire right chest, but were heard the strongest over the point where the pulsation was visible. At this time tentative diagnosis was made of pneumothorax with a possibility of a tuberculous origin. Also a condition of dextrocardia was thought probable.

March 16, 1923.—The physical signs were very similar to those found at the last examination, except that the ringing quality of the percussion note was less marked and fewer râles seemed to be present. The position of the heart seemed somewhat more to the left so that pulsation could be seen and felt in the fifth interspace to the left of the left border of the sternum but considerably within the normal location of the apex beat. A heavy, muco-purulent sputum is constantly raised.

March 17, 1923.—The heart has returned to the left somewhat, taking a position behind the sternum, the sounds are quite as forceful as ever. Friction rub heard distinctly over both sides anteriorly.

Notes by Doctor Geisler: Lungs.—Left lung shows a compensatory hyperactivity; right lung diminished expansion in the upper lobe, a few sonorous râles are heard and the respiratory note is exaggerated. Middle or lower lobes show dulness varying in intensity on change of posture but never quite clearing, with distant breathing in some parts and absent breath sounds in others. Vocal resonance well transmitted and occasionally egophonic in small areas. Probably due to a loculated effusion or a thick, fibrinous effusion.

March 18, 1923.—General condition not so favorable as has been. The physical signs are about the same. The heart area is well defined about one inch to the right of the sternum, where the pulsation is visible in the fourth interspace. Râles diminishing. Ringing quality of percussion note somewhat diminished anteriorly. Posteriorly a decided ringing quality is heard at the level of the spine of the scapula. Breath sounds here are exaggerated and the spoken voice is so loud at this level that it is almost painful to one's ears. Spoken voice slightly increased at the base, where a suggestion of egophony is present. Râles are heard as well posteriorly.

Drainage is free from the incision. The pus is thin and watery, with a very foul fecal odor. There is a definite suggestion of a mass present in the right pelvic area and hypogastrium. This is moderately tender. Patient has no pain at the site of the incision but complains of epigastric distress.

March 19, 1923.—The ringing note has almost disappeared in the anterior chest. Heart maintains the same position, the râles are still present, and the expectoration continues. General condition is somewhat better, drainage profuse.

March 21, 1923.—Left chest still hyperresonant everywhere. No cardiac dulness. Apex beat visible in fourth interspace, one and one-half inches right of median line. Heart sounds heard throughout right chest. Hyperresonance in right chest disappearing and the greatest resonance is over the right upper lobe. Lying on the left side heart dulness moves to one inch to left of median line and apex beat felt in fifth interspace at right of sternum. Upper lobe posteriorly the broncho-

scopy has disappeared, but the râles are present. Middle lobe posteriorly is silent. Lower lobe posteriorly is silent. Tactile fremitus present posteriorly, most marked over upper and middle lobes.

March 23, 1923.—Right border of heart one and one-quarter inches right of median line. Beat not felt on the right so distinctly as before. Friction rub heard throughout entire right chest. Posteriorly the middle lobe is silent, hyperresonance is absent now anteriorly.

March 25, 1923.—Heart has moved over slightly toward the left. Sounds not so distinct in the right chest but still heard there. Friction sound has entirely disappeared. Incision healing, drainage very slight, and the foul odor has disappeared. There is a mass present in the right abdomen about the size of the back of a hand.

March 27, 1923.—Very difficult to feel heart and pulse on the right but probably felt one inch to right of mid-sternum. Definitely felt in fifth interspace one and three-quarters inches to left of mid-sternum. He has a definite mass in mid-abdomen below the umbilicus to the inner side of the incision, probably a secondary abscess. This would account for his febrile condition.

March 29, 1923.—Abdominal mass is still palpable, not tender, temperature is normal. Is probably going to take care of this infection himself. The hyperresonance over the left chest is disappearing. Heart dulness is at the right border of the sternum and the left border is one-half inch to right of nipple. There is a slight cardiac pulsation visible in the third and fourth interspace to the right of the sternum, but is not palpable.

April 18, 1923.—Patient's abdominal condition is entirely cured. He developed an acute otitis media, left ear April 2, 1923, the right ear April 3, 1923, for which he has been treated by the ear department with incision of both drums and the ears douched. His temperature has gradually become normal and has been so for nine days and the ears are no longer draining. Patient discharged recovered.

Stated Meeting Held January 7, 1924

The President, Dr. John H. Jopson, in the Chair

HERNIA THROUGH THE FORAMEN OF WINSLOW

Dr. Maurice Picton (by invitation) read a paper with the above title and presented the patient whose history had prompted the study.

GANGRENE OF APPENDIX RESULTING IN COLIC AND DUODENAL FISTULÆ

Dr. John B. Deaver presented a young man who was admitted to the Lankenau Hospital, October 19, 1916, with the history that three days before his admission, he was seized with general abdominal pain which in a few hours localized in the lower right abdomen. He neither vomited after the onset of pain nor after the pain localized. Twenty-four hours before he came into the hospital he took citrate of magnesia, which was followed by

not only intense pain, which again became general over the abdomen, but also by vomiting. Examination showed a diffused peritonitis of lower abdomen and no localized point of exquisite tenderness, but the presence of peristalsis beyond and around the area of peritoneal involvement, and the absence of peristalsis over the inflamed portion. Leucocyte count 30,000 with 89 polymorphonuclears, moderately high temperature and rapid and irregular pulse. Treatment, anatomic and physiologic rest.

Two days after admission, the diffused peritonitis having subsided to a localized peritonitis and being able to definitely localize a point of exquisite tenderness low down in the lower right abdomen and well out, the abdomen was opened. The appendix was in the false pelvis, gangrenous and ruptured; there was pus in the pelvis. Exploration of outer pericolic groove negative. Condition satisfactory until November 9, ten days after operation, when it was evident that a secondary abscess had formed in the pelvis, with incomplete bowel obstruction.

November 10, a second operation was done, evacuating a large amount of pus from the pelvis and relieving obstruction of the sigmoid due to angulation and adhesions of the bases of the limbs forming sides of triangle. Drainage.

November 17, a fecal fistula through the original incision developed with great pain in the upper right abdomen, with slight pain in left upper abdomen.

November 23, the fecal discharge was profuse and the pain in the right upper abdomen was intense.

November 25, a collection of pus beneath liver was drained. A localized necrosis of the duodenum and the hepatic flexure of colon was exposed; the necrotic areas in both duodenum and hepatic flexure of colon were turned in and oversewn. Drainage of abscess bed.

November 28, a duodenal fistula has formed, fluid taken by mouth escaped by way of fistula; still fecal drainage.

December 3, patient very weak, all fluid nourishment given by mouth escaping by way of duodenal fistula. Skin edges of upper wound much irritated. Fecal drainage through lower wound profuse.

December 4, a large opening in the duodenum was exposed, closed, and a posterior no-loop gastro-enterostomy made. At this operation a small pus collection at site of splenic flexure was evacuated and drained. Following the last operation the patient gradually improved and was discharged January 15, 1917, with slight drainage from upper wound, which was not entirely healed but granulating, and the fecal fistula still present. The drainage from the upper wound ceased in three weeks and the fecal drainage from the lower wound in six weeks after his discharge.

Doctor Deaver added that he had seen a number of duodenal fistulas and had gotten away with most of them by almost immediate operation. Delay is dangerous on account of the loss of nutriment and starvation as a consequence, therefore he operates immediately, in some instances being able to close the fistula, in others making an amputation of the duodenum below the site of the fistula and removing with the upper duodenum the pylorus, and last a posterior gastro-enterostomy. These are troublesome and anxious cases, but are amenable to treatment.

Dr. George P. Muller said that in 1909, he operated on a patient with perforated duodenal ulcer and simply sutured the perforation without gastro-enterostomy. Ten days later a duodenal fistula appeared and discharged

bile and pancreatic juice, greatly excoriating the skin. Accordingly, a posterior gastrojejunostomy was done through a second incision and in a week the fistula had closed.

FRACTURE-DISLOCATION OF UPPER END OF HUMERUS

DR. JOHN B. DEAVER presented a man, age thirty-seven, who was admitted to the Accident Department of the Lankenau Hospital, August 9, 1923, complaining of pain in the right shoulder and arm. He had fallen ten feet from a scaffold, striking his right hand forcibly against a wall. Immediately after falling he found that he could not move the right arm. X-ray showed an oblique fracture of the anatomical neck of the right humerus, the head lying beneath the coracoid process.

Operation.—August 18, Doctor Pfeiffer. Head of the bone reduced and nailed to shaft. Arm dressed in extended position and plaster bandage applied. X-ray taken a few days following showed recurrence of the dislocation.

On the 27th of August, Doctor Pfeiffer and Doctor Deaver removed the nail, reduced the head of the bone and brought the shaft in line with the head, arm dressed to side.

DR. DAMON B. PFEIFFER said that he found the head of the bone had been driven deeply into the pectoral muscles and the track had contracted to such an extent it was almost impossible to get it back. It consumed time and produced much traumatism in replacing it. The head was connected to the glenoid by only a single strand of capsule. He therefore nailed it to hold it in place and replaced the head in the socket. Unfortunately during the process of putting on the plaster bandage, the dislocation reproduced itself. Had the patient been on a special fracture table, he doubted if this would have occurred, but the movement incident to transferring the patient to another room, where the bandage was applied, permitted the head, which was so loosely held by the capsule, to fall out of place. The problem in these cases is to get abduction after healing has taken place and this is what he had in mind in attempting to put up the arm in an abducted position. Possibly this can best be done by traction and counter-traction with the arm at right angle to the body, but in view of the extensive tearing of the capsule in these cases, all such measures involve considerable risk of redisplacement. The question of failure of the capsule to reattach itself to the normal points must also be considered as habitual dislocation might easily result. Of course, the bone is most easily held in position with the arm at the side and we must wait for further experience and development of means of fixation to say what is the best method of dressing from the standpoint of future function.

LUNG ABSCESS AND PYONEUMOTHORAX FOLLOWING TONSILLECTOMY

DRS. E. B. HODGE and E. R. MURPHY presented a little girl, aged six years, who was admitted to the Children's Hospital of Philadelphia, September 22, 1923, with the following history:

On August 29, 1923, under ether anæsthesia, tonsillectomy was performed. She remained in hospital 24 hours, was then taken home where she remained

in bed for the next three days. On the fifth day following the operation, she was allowed to go to school, apparently well.

On September 14, 1923, sixteen days following operation, she returned from school, complaining of pain in the stomach, coughed a great deal, and was short of breath. She was put to bed and on the following morning had a chill, vomited and became blue.

When admitted to the hospital the child looked extremely ill. Temperature 105. Pulse 150. Respirations 70. She was cyanotic, and expectorating large quantities of purulent sputum. A diagnosis of lung abscess and pyopneumothorax was made. Under local anæsthesia the left pleural cavity was drained through an intercostal incision. The general condition improved and the temperature gradually fell to normal.

On November 7, 1923, bottle blowing was begun. This was followed by a sharp rise in temperature and a return of the purulent sputum. The bottle blowing was stopped, the temperature again fell to normal, and the purulent expectoration ceased.

December 1, 1923, all drainage was removed, the wound closed promptly. The temperature remained normal. There has been a rapid gain in weight. The physical examination at the present time shows no pathology in the left chest, which is confirmed by the X-ray.

DR. GEORGE FETTEROLF remarked, there are entirely too many of these lung abscesses following tonsil operations. The literature is full of them. The relation of cause and effect is often not recognized, the usual history being that the patient comes in for a "bad cold on the chest" and the fact that he has had a tonsil operation frequently has to be elicited by questioning, it eventually develops that there had been a tonsil operation and a week or so later the patient began to spit up unpleasant material. In the majority of cases the patient regards it entirely as an independent proposition from the tonsillectomy. Then, again some of these cases may be treated as tuberculosis, not as lung abscesses. As regards etiology, it has been pretty commonly accepted that they are generally of inhalation etiology, but when it is realized that in one series of 202 cases the proportion done under local anæsthesia was approximately 20 per cent., it puts a new angle in the situation, and makes one think a little more of terms of embolic origin of some of these cases. With this idea in mind last winter Doctor Fox and he did some tonsillectomies on dogs, infecting the wounds and introducing infected sutures into the wounds. As a result of these experiments they found in the paratonsillar tissues interstitial hemorrhages, many thrombi, necroses and bacteria. In other words, local conditions were such that emboli readily could loosen and travel down the internal jugular and eventually into the lung. The three factors in producing septic emboli are traumatism, sepsis and muscular action, and it would be pretty hard to find a place where these three would be more ideally combined than around the tonsil fossa; when the tonsil is taken out, a certain amount of traumatism results, the area is exposed to the constant presence of bacteria, and the throat muscles are in more or less constant action. These findings, so far as paratonsillar tissue is concerned, and again, the fact that a great many of these cases follow local anæsthesia, suggest that

more attention should be directed to the embolic nature of the affection and less to inhalation. Efforts to prevent lung complications so far have been directed towards keeping the trachea free of blood, etc., with no thought of the wound. The practical developments of these experiments would be to seek for lines of procedure which might add to the safety of the operation. In the first place every patient before tonsillectomy should be given sodium bicarbonate in the hope of preventing vomiting and acidosis, as with vomiting there might be some inhalation of the vomitus and infection of the lung. The next point is light anæsthesia to preserve as far as possible and to favor a quick return of the coughing reflex. The third point is the use of a good suction apparatus to keep the throat as free as possible and the fourth as rigid asepsis as can be secured. The fifth point and the point he wished to emphasize most of all is when the surgeon has to pick up and tie off a bleeding point not to introduce the ligature with a needle, but to use a surface tie as would be done anywhere else in the body, for it is not possible to introduce a suture into the tonsil area, without introducing some bacteria and thus greatly increasing the probability of infecting any thrombi there. An interesting point is that lung abscesses began to be reported when the type of tonsil operation changed and this was about 1912. Up to that time they used a tonsillotome or punch and sliced off the readily accessible parts of the tonsil, in each case a certain amount of tonsil being left behind as well as most of the capsule. When the complete tonsil operation was taken up, the capsule, that wall of fibrous tissue between the lymphoid tissue and the muscles, etc., and the throat, was taken away. In view of the possibilities of septic embolism that might thus be encouraged, a further deduction is that perhaps this type of tonsil operation is not based on correct principles. It may be if one could remove the lymphoid tissue and leave the firm fibrous capsule behind they would be protecting the underlying tissue. An ideal procedure would be to take out the lymphoid tissue and leave the capsule. Whether or not this is practicable only time and further study will determine.

Dr. Herbert Fox remarked as to the pathological changes that are in the paratonsillar tissues after a tonsillectomy, that if one will visualize the granulation tissue that must occur about an operation area, particularly if it is infected, it will require little imagination to see how thrombi can start about a tonsillectomy wound, perhaps extend out as far as the main branches of the veins that empty directly into the jugular. They had seen thrombi partly attached and partly loosened in veinules in the tonsillar beds. One can easily follow the extent of these thrombi in the main venous trunks; all know that thrombi grow with advancing infections of the pharyngeal wall or of the tongue. Next as to genesis of pulmonary abscess, it is only necessary to assume that there are small emboli which produce small areas of congestion and secondary to that thrombosis, local thrombosis. From such a small focus it is perfectly possible for larger patches to develop. If one realizes that it is not necessary for massive infarcts to occur, that small infarcts can produce

pulmonary abscesses, that there are two varieties of pulmonary abscesses, that which is infiltrated, massive, possibly secondary to inspiration, that which is disseminated, small and almost certainly due to emboli.

Dr. John B. Roberts said that the facts mentioned by Doctor Fetterolf had always impressed him when he had seen this operation done. The etherizer is usually giving unnecessarily deep anæsthesia. There is no necessity for a great deal of ether in this tonsil operation unless one has some other reason for wanting to obtain profound anæsthesia. The clearing of the throat is often inefficiently done, even by those who use, if they be laryngologists, suction apparatus to get blood and mucus out of the pharynx while working. The form of apparatus some otolaryngological surgeons use has seemed to him to be very unsuitable for such an easy operation. It reminds one of the crude and clumsy way by which in years past hysterectomy was done by the extraperitoneal method. Surely no crushing, clumsy ecraseur is needed to control the bleeding arising from removing tonsils.

To do the work neatly, quickly and safely, one needs an etherizer, who will not overwhelm the patient with the drug, an etherizing apparatus with a hook-like metal mouthpiece and a rubber hand blower under the control of the etherizer's own fingers. The patient should lie supine with mouth held open by means of an incisor gag, and the tongue drawn out by means of an aseptic silkworm gut thread thrust with a sterile needle through the tongue. This device is harmless and superior to holding the tip of the organ with tongue forceps. A suction tube should be in the hands of an assistant and a suction pump be attached to it to be used occasionally for drawing blood, mucus and saliva out of the child's throat. A good head mirror will give illumination.

The amygdalectomy is readily performed, under this preparatory technic, with a vulsellum to draw the tonsil up from its bed, in the surgeon's left hand, and a bistoury or a midpoint scalpel in his right. A small blade-pointed scissors, curved on the flat, will often be found a useful additional instrument for dissecting out the entire gland. Should one or two vessels bleed, a hæmostatic forceps is employed to seize the open end of the artery, left in place for a few minutes; and removed after twisting the grasped vessels two or three turns.

It must be very seldom that any serious hemorrhage can occur then unless the operator cuts very much more deeply than required. Even then, leaving the hæmostats in place a little longer is probably all that will be necessary. If by any possibility there should be recurrence of bleeding, the hæmostatic forceps may be left in position and the teeth closed on that handle sticking out of the patient's mouth. The nurse may support the chin so as to close the mouth and steady the instrument in place until the surgeon removes it. It will not be safe to bandage the mouth shut until all risk of vomiting is over.

It is well, in order to make the operation easy, to have scissors, forceps and hæmostats with long and rather delicate handles. The habit of some

laryngologists of stopping a bleeding vessel with a suture puckering up the tissues does not seem wise. It makes a sort of pocket at times in which secretions or blood may accumulate and become septic. Instead of torsion with hæmostats, an old-fashioned tenaculum may be hooked into the tissues alongside of the bleeding artery and given a turn, so as to twist the structures and stop the flow of blood. The flat handle of the hook-shape tenaculum protruding from the mouth may be kept from relaxing the twist of the palatal and columnar tissues by keeping the teeth shut upon it.

PERIARTERIAL SYMPATHECTOMY FOR SCLERODERMA

DR. GEORGE P. MULLER reported the case of a woman, thirty-seven years of age, who was referred by Doctor Riesman to his service at the University Hospital, October 12, 1923. About five years ago menstruation ceased after a miscarriage and shortly afterwards was first noted swelling of the fingers. Later they became blue on exposure to cold, and soon the definite appearance of sclerodactyly was noted. Recently, some evidenee of the disease is noted in the face. At present the hands present the typical picture of scleroderma. She has pyorrhœa. Blood Wassermann test is negative. Basal metabolic rate +1. Blood-pressure is S. 90, D. 68 in right arm and S. 80, D. 60 in the left.

On October 18, sympathectomy was done on the right brachial artery. The artery, when exposed, was about one-quarter the normal size and contracted still further on manipulation. The wound healed perfectly and the improvement was sufficiently marked for the patient to insist on having the left side operated on; this was done October 25 and a similarly contracted artery found. On January 7, 1924, the patient was seen and expressed her belief that considerable improvement had occurred; the hands still became quite blue when cold, but she could handle things better.

Scleroderma seems to be a disease of unknown etiology and is rather rare. Lewin and Haller believe it to be an angio-trophoneurosis. Consequently sympathectomy is justifiable in view of the poor prognosis even if amelioration only is obtained. Doctor Muller has only noted one other case (Horn, 1923) in the literature so treated and the result was an improvement as in the case reported.

PERIARTERIAL SYMPATHECTOMY FOR TROPHIC ULCER

DR. GEORGE P. MULLER reported the case of a man, thirty years old, referred by Doctor Pierson to his service in the University Hospital, October 24, 1923. Eight years ago he suffered a lacerated wound of the right ankle from a mowing machine. The tendo-Achillis was severed and sutured. Since then has had disability and swelling. Four years later a fissure formed on the plantar surface of the heel which progressively grew worse until a deep ulcer developed, which now measures 3 cm. in diameter. It is undermined and suppurating. The right leg sweats profusely. On October 27, a right femoral periarterial sympathectomy was performed. The vessel contracted during manipulation. The ulcer on the heel was trimmed and treated with glycerine dressings, later with mercurochrome. The ulcer began immediately to fill with granulations and on November 15, a single Reverdin graft completed healing.

On January 7, 1924, the patient reported that the foot was entirely normal and that he was walking without discomfort.

In an experience of over thirty periarterial sympathectomies Doctor

Muller thinks that this was the most satisfactory of the series. The result was so prompt in a condition of long standing as to be surprising. Bruning has pointed out that the appearance of trophic ulcers is delayed until a neuroma has formed or pressure from the cicatrix begins to act. The tonus of the sympathetic is augmented and sympathectomy acts by lowering the tonus proximal to the field of operation. Leriche states that relapse is possible if the cause of the trophic trouble has not been removed, and that the cause is not always removed by the sympathectomy. If relapse occurs in this case Doctor Muller thinks that the posterior tibial nerve must be investigated in the region of the scar for a possible neuroma.

CONGENITAL FISTULÆ AND CYSTS OF THE NECK

DR. BENJAMIN LIPSHUTZ read a paper with the above title, for which see page 499.

DR. A. P. C. ASHHURST asked whether such a thing as branchial carcinoma exists? It has been taught for many years that such a thing exists. But no less an authority than Bland-Sutton says it is a myth, and that in every case that has been called a branchial carcinoma if autopsy is done there is a primary growth in the oropharynx of which this tumor of the neck is only a metastasis. Having himself recently operated on a patient with which he diagnosed as branchial carcinoma, and having had the good fortune to get an autopsy after the patient's death, he found in the pharynx a carcinoma. He did not see why the carcinoma inside of the pharynx and the carcinoma in the neck could not have developed in different parts of the remains of the same branchial cleft.

DOCTOR LIPSHUTZ replied that it was difficult to answer with definiteness Doctor Ashhurst's question. The origin of the branchial and thyroglossal fistulæ as interpreted in his contribution is a problem of embryonal cell rests; and if one accepts Cohnheim's theory of the genesis of cancer, then these embryonal cell rests offer a tenable explanation for primary carcinoma in the neck. But until more is known about the question of the degeneration of embryonal tissue, the state of knowledge of this problem will remain where it is to-day.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held January 9, 1924

The President, Dr. Eugene H. Pool, in the Chair

TOTAL AVULSION OF THE SCALP

Dr. Clarence A. McWilliams read a paper upon the proper treatment of total avulsion of the scalp with remarks on Thiersch and free, full-thickness skin grafts and pedicled skin flaps.

Dr. Albert S. Morrow said that: He considered this work most discouraging; one is constantly meeting failure or only partial successes having to do the grafting over and over again. He had one case, first seen last March, on whom he was about to reoperate for the eighteenth time. These cases require an immense amount of patience on the part of the operator and very full coöperation on the part of the patient. As to the Thiersch graft he had never had any good results from free, full-thickness skin grafts, though this might be due to his not having selected his cases properly, the circulation in the surface grafted not being as good as it should have been. Most of his own experience had been with pedicled grafts and he had found that the long pedicle grafts could not be cut loose at the first operation or they would slough promptly; they should be left in place for ten days or two weeks and then cut loose and sewn in place.

Dr. Carl G. Burdick said that he considered it better to leave both ends of a tubed pedicle graft attached for at least ten days. He felt that the method of after-treatment in skin grafting was of considerable importance. On the Children's Surgical Service at Bellevue they covered the grafts with paraffin mesh gauze, and employed the Carrel-Dakin technic over the mesh. This promoted the absorption of the discharge, especially if it was impossible to entirely cover the granulating area with grafts.

As regards cases of contracture of the axilla, the difficult point to obtain was the apex of the axilla. In two cases which he had operated he had employed a method suggested by Doctor Abbe, which consisted of a tubed pedicle with epithelium on the inside of the tube. This perforated the web at the point where the apex of the axilla was to be formed. After the graft had taken, the web was divided and the resulting denuded areas covered either by a full thickness or a Thiersch graft.

Dr. Robert T. Morris said that the cutting of a strip of skin several days in advance of its transplantation, had larger significance than the simple point of giving opportunity to determine if any sloughing was to occur at

the margins. A much more important principle rested in the fact that a certain polarity of repair materials, carried them in excess to the strip of skin which was in the midst of physiologic processes of repair by the time for its transplantation. This point is demonstrated in some experimental grafting work with plants belonging to species that are grafted with difficulty. If one turns up a strip of a bark carrying a bud, then replaces the strip and waits for a week, transplanting of the graft may be successfully accomplished, in cases in which it would otherwise have been a failure. It is a protoplasm question and a physiologic repair material question which applies to all organic life.

Another point that Doctor Morris wished to make was the advantage of employment of scrotal tissues for full thickness grafts when such material was available for any given case. It was his belief that Doctor Dawbarn had first made this suggestion many years ago, but Doctor Morris had found it to be valuable in practical application.

Dr. Charles Gordon Heyd said that in cases of contracture of the neck it had been his experience that there was usually considerable scar tissue or fibrosis in the muscles and that even if normal skin were transplanted there was a great possibility of contracture. He then reported a case of complete avulsion of the scalp which in every way paralleled the case of Doctor McWilliams. The scalp had been avulsed by machinery, it had been sutured back on the head and sloughed. The patient was admitted to the Post-graduate Hospital, 103 days after her injury. She had a complete grafting of the whole scalp in 186 days. They had employed 12 autodermic Thiersch grafts, 6 autodermic whole-thickness grafts and 6 isodermic whole-thickness grafts. Doctor Heyd believed that one of the isodermic grafts had been successful. All the Thiersch grafts took.

Dr. James M. Worcester said that the use for a full thickness graft was in a place where one wanted to avoid fibrosis and if it is successful it will be more advantageous than a Thiersch graft. But if the place is where one has to excise scar tissue, particularly the fingers, it is impossible to get a base of normal tissue. It is decidedly limited in its application.

Dr. Hugh Auchincloss said that he remembered Doctor McWilliams about ten years ago removing a piece of skin and subcutaneous tissue and putting it in a bottle of sterile salt solution where it remained at room temperature, in the House Surgeon's room, over night. The next morning, on learning that there was a case to be grafted in the Out-service Department, he suggested that this piece of skin be used. He made a Thiersch graft from it and used it on a patient that same day. It took and remained all right. Sometimes they did take, though more often not. About X-ray burns; Doctor Porter, of Boston, had treated many of those and reported something like 20 or 30 cases several years ago. Many of these cases were successfully treated by excision and Thiersch grafts. In the experience of the speaker during the past ten years, some of epitheliomata and some of purely granulating areas on the back of the hand, the fingers and nails,

it was astonishing how, when the ulcerating area had been excised and the graft put on, practically every graft took, whether there were infection or not, and the immediate relief from pain and discomfort was very gratifying. As to the full thickness graft, for the past two or three years the speaker has used this in the radical operation for carcinoma of the breast. At some point in the margin of the wound flaps there is generally reduplication of skin. This excess is cut away, the fat completely trimmed off with blunt scissors and the graft simply placed on the chest wall and retained by accurately placed bits of gauze fastened by sterile adhesive strips. Some parts of the graft, and in many the whole graft, has taken in every one of those cases. He was convinced of the usefulness of this procedure. As to the transplant of hair to the eyebrow, the double pedunculated transplant, first to the arm and then to the forehead, might be useful.

Stated Meeting Held January 23, 1924

The President, Dr. Eugene H. Pool, in the Chair

RESULTS OF TREATMENT FOR FRACTURE OF THE NECK OF THE FEMUR (FOUR CASES)

Dr. Royal Whitman presented four patients treated by the abduction method for fracture of the neck of the femur to show functional recovery.

1. A woman of seventy-three years of age, treated in 1921, for subcapital fracture.

2. A man sixty-eight years of age, treated in May, 1923, for extracapsular fracture with avulsion of the trochanter minor and splitting of the shaft.

3. A man fifty-five years of age, treated in 1917, for intracapsular fracture.

4. A woman fifty-three years of age, treated in 1921, for intracapsular fracture.

All of the patients walked without a limp.

Doctor Whitman said he presented these patients particularly to illustrate functional recovery which was still generally supposed to be impossible. Indeed, according to a leading treatise on fractures, " Restoration of form and function was rarely to be attempted or even sought in treatment."

It might be recalled that at a recent meeting, one of the members had apparently failed to recognize the comprehensive effectiveness of the abduction treatment, since he had mentioned as practicable alternative artificial impaction, the insertion of metal screws, primary excision of the head of the femur and primary autogenous bone pegging. He thought the last of these was the only one that merited serious consideration; but even admitting that the bone graft might induce union which would not have followed secure apposition, the number of cases in which such an operation would be either advisable or practicable was insignificant. It might be noted furthermore that accepting the results as representative of an operation evidently skilfully performed

and in which union had been attained the results in comparison with those presented this evening are far inferior, since in all instances the limp was pronounced and joint motion restricted by residual deformity.

Dr. Joseph A. Blake said that he did not agree with Doctor Whitman in one respect and that was that he had seen good results follow the use of Doctor Whitman's method, by men who applied it without his (Doctor Whitman's) personal instructions. The speaker had counselled its employment for nearly every case of fracture of the neck of the femur that he had seen. He considered the results that had been obtained in old cases were remarkable, and in recent cases union took place in the normal time for an ordinary fracture.

Doctor Whitman rejoined that the chief obstacle to progress had been the teaching, embalmed in the text-books, that fracture of the neck of the femur was an exception to all other fractures in that its treatment on surgical principles, even if practicable, was both hazardous and futile. Consequently there had been no standard to which an advocate of efficiency might appeal nor official recognition of the fact that there could be but one effective treatment of the fracture because there was but one method adapted to the anatomical construction of the injured part. He thought now that faith in conventional authority to assure immunity for inefficiency and neglect had been shaken, that the chief deterrent to the general adoption of the abduction treatment was lack of training for a method that required beside a certain understanding of mechanics and anatomical topography the adjustment of a secure and comfortable plaster splint. In fact, he had rarely seen these conditions fulfilled except by those who had come directly or indirectly under his personal supervision. He thought, therefore, that the good results reported by others who employed the principles of the abduction method with variations in its application of which he did not approve, were the strongest evidence in favor of its inherent superiority and effectiveness.

PROGRESSIVE FIBRINO-PURULENT PERITONITIS

Dr. Walton Martin presented a man, fifty-four years old, who was admitted to St. Luke's Hospital in June, 1918. On admission a distinct mass could be felt to the left of the median line and just below the level of the navel. His temperature was 102, his pulse was rapid, he looked septic. His illness had begun three weeks previously. While sitting reading at about ten o'clock in the evening he was suddenly seized with violent epigastric pain. He caused himself to vomit by taking large quantities of warm water but obtained no relief. The pain continued during the night, confined to the epigastrium and not radiating to the back or toward the lower abdomen. At one o'clock he called his physician, who had been treating him for diabetes for the past six months, and his regular family physician, but did not see either until the next morning, twelve hours after the onset of his trouble. The physicians disagreed, one wished to have an immediate operation, believing that he was suffering from appendicitis and peritonitis, the other advising against operation and attributing his pain to cholecystitis.

During the next two days he grew worse, the abdomen became somewhat distended, his temperature varied between 101 and 104, his pulse became very

rapid. The extremities were cold and the surface circulation was poor. He did not continue to vomit; he passed gas by the bowel. The pain continued in the upper abdomen. Several physicians had been called to see him. A well-known consultant who saw him on the fourth day of his illness said that he had general peritonitis, that he only had a few hours to live, and that it was too late for surgical interference.

Doctor Martin saw him at this time and felt so uncertain as to the situation of the focus of infection and so convinced of the gravity of his condition and the danger of doing an exploratory operation that he advised waiting. The patient gradually grew better and a mass and local tenderness made their appearance beneath the middle of the left rectus and he was sent to St. Luke's Hospital. At operation, on cutting through the abdominal wall over the mass, several ounces of foul-smelling pus welled up into the wound.

He left the hospital in eight weeks; the discharge had ceased, the wound had closed. He did not, however, regain his health. The following autumn he again had temperature every afternoon and a mass gradually formed in the lower right quadrant. He was admitted to the hospital and two intra-abdominal abscesses were opened, one through the lower right rectus and the other laterally near the crest of the ilium. They apparently did not communicate. His wounds closed but he continued in poor health. From time to time he had attacks of pain and several times a febrile reaction. A small hernia formed in the scar through the right rectus.

In the end of November, 1919, eighteen months after his original attack, the abdomen was opened, the cæcum identified, the appendix dissected out of a mass of dense adhesions and removed. It showed chronic inflammation and had apparently ruptured at one point. The abdominal wall was repaired. The patient made a good recovery. He has had no abdominal symptoms since and, except for his diabetes which is controlled by restriction of diet, is well.

The case report seemed to Doctor Martin of interest, first, because the patient recovered from a general peritonitis without the removal of the original focus of infection; second, because he presented a variety of peritonitis in which local abscesses are formed one after another in various parts of the peritoneum, the walling in of the infection seeming to be incomplete and the infection slowly spreading from point to point.

If the advice of the physician who first saw him had been taken, he would have escaped a prolonged illness and much suffering.

LATE ABSCESS FOLLOWING APPENDICITIS

Dr. Walton Martin presented a young man twenty-five years old, who had been referred to him five years ago for pain in the right side and hip. He was in poor health. He had no temperature, there was no restriction of motion in the joint, there was no local tenderness. An abscess had formed about a month previously in an old scar, the site of an operation done when he was two years old. It had opened and drained. The scar was situated in the right lower quadrant of the abdomen.

An X-ray plate was taken of the right iliac region and hip. The bone was normal but there was a shadow of a large pin in the right inguinal region beneath the old scar (Fig. 1).

The scar was incised and a small tract lined with granulations followed down. It led to a cavity containing a small amount of foul pus and a large rusty pin embedded in fecal concretions. The pin was removed and the abscess cavity drained. The wound closed but three times during the next three years, there was pain and tenderness in the region of the scar, and the

abscess was reopened, discharging each time a small amount of foul-smelling pus.

In May, 1923, the cicatrix was excised, the abdomen opened, the cæcum and appendix identified and delivered from the wound. The sinus wall and the appendix were removed and the abdomen closed. He made a good recovery and has remained well. The sinus led to a hole in the appendix.

During infancy the boy had evidently had an acute appendicitis with a circumscribed abscess and a foreign body which had escaped from the appendix into the abscess cavity. The abscess had been incised and the foreign body and the small cavity had remained for fifteen years, causing attacks of

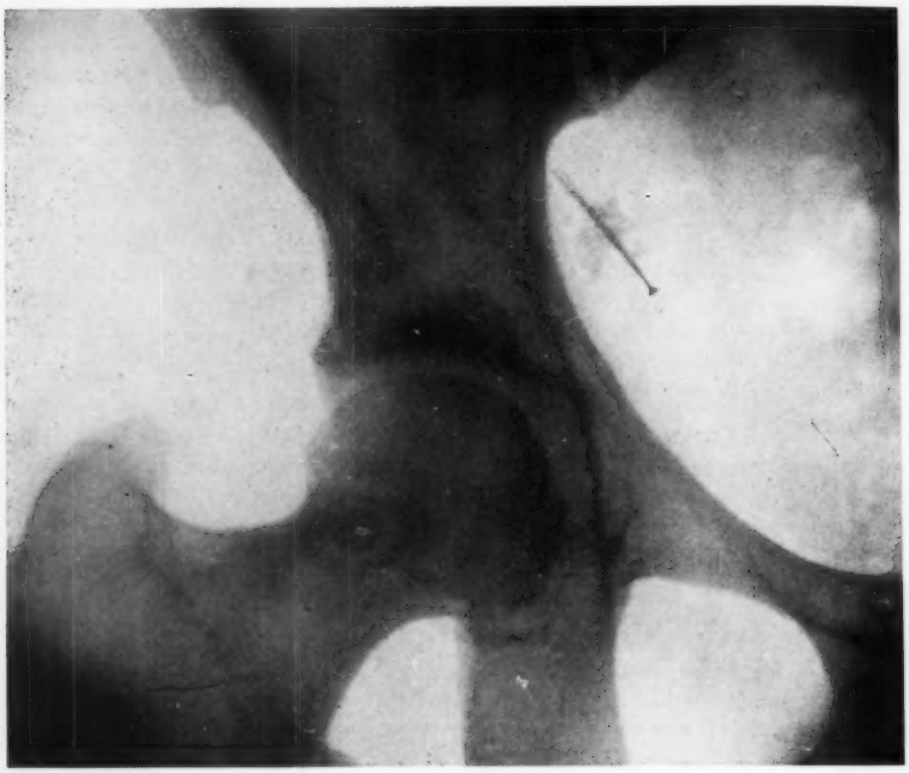

FIG. 1.—Appendiceal abscess containing a pin which was removed sixteen years after the original infection (Walton Martin).

pain referred to the side and hip. Probably the cavity incompletely drained through the appendix.

Doctor Martin presented also a man forty-three years old, who was admitted to St. Luke's Hospital in April, 1923. On admission the patient looked ill and septic. He had been unable to work for five months, much of the time being in bed. He had pain and tenderness in the right lumbar region, had no appetite and had lost forty pounds in weight. He had had four or five attacks of very severe pain in the lower right lumbar region; there had been no chills and no urinary symptoms. He had never been ill before.

Examination showed a large, swollen area slightly red and very tender just above the posterior half of the crest of the ilium. The temperature on

admission was 102 and the pulse rate 114. X-ray and cystoscopic examinations were negative.

On April 4 an abscess containing much pus with a foul odor was opened and drained through an incision just above the crest of the ilium. The finger passed into a large cavity which extended over the crest of the ilium into the iliac fossa. The abscess was evidently extra-peritoneal. The man improved but continued to have evening temperature and the incision contracted down to a discharging sinus.

In June, 1923, believing that the abscess must have originated in the appendix, the abdomen was opened through an intermuscular incision. The cæcum was identified and the base of the appendix isolated. The appendix was divided near its base and removed. It was largely retrocæcal, the end had sloughed and a probe passed into the lumen appeared in the abscess cavity history of appendicitis. The case was evidently one of "appendicitis ileo-inguinalis subfascialis," which had burst through the iliac fascia and passed out over the crest instead of working downward under Poupart's ligament.

HIGH ENTEROSTOMY FOR ILEUS. JEJUNOSTOMY

DR. SEWARD ERDMAN presented a man, aged sixty years, who was admitted to the Second Surgical Division of the New York Hospital, on September 23, 1921, with symptoms of ileus complicating a ruptured appendix abscess. For two weeks he had been sick at home and in bed. The onset had been with general abdominal pain, nausea and diarrhœa and vomiting. After the first 24 hours the pain localized in the right lower quadrant and persisted in that area for six days. Five days before admission, although the local pain was less and he had not vomited since the second day of his illness, vomiting recurred and persisted. His physician says that the vomitus has become fecaloid and for past 36 hours there has been no passage of fæces nor gas.

On admission there presented a poorly nourished man, markedly prostrated and desiccated, who appeared almost *in extremis*. There was regurgitant vomitus of dark brown fecaloid material. The temperature was 102, the leucocytes 27,000, with 88 per cent. polymorphonuclears; the pulse and respirations were very rapid. The abdomen was much distended and rigid with tenderness over all but maximum in the right lower quadrant. Operation was at once performed after gastric lavage.

As the symptoms of ileus predominated the picture, it was decided to perform a jejunostomy at the same time that the appendix abscess was drained. (*a*) Under gas anæsthesia, a MacBurney incision was made and an abscess about the cæcum containing three ounces of thick pus was opened. The appendix could not be readily felt and was not searched for. (*b*) An incision was now made above and to the left of the umbilicus and a jejunostomy performed by the Witzel method, using a No. 18 French catheter with end and side openings. The intestines in this upper left quadrant were distended and very red and bathed in turbid fluid. Upon inserting the tube into the jejunum, about 700 c.c. of foul-smelling brown fluid and considerable flatus was expelled.

Post-operative Notes.—For three days there was profuse drainage of about 1500 c.c. per day. On the second day and thereafter there occurred small liquid involuntary stools. The tube was removed on the fourth day with only very slight leakage for two days more. After the operation the distention was at once appreciably diminished, the patient was much more comfortable and there was absolutely no recurrence of the vomiting. A fecal

fistula in the appendix wound discharged from the fourth to the seventeenth day. The man was discharged on the twenty-fifth day after operation.

Although a direct result of the spread of the peritonitis from the appendicitis, the ileus in this case, which did not manifest itself until the seventh day of his illness, was probably of the mechanical variety, the type in which jejunostomy is almost uniformly successful.

DOCTOR ERDMAN presented also a colored boy, aged twelve years, who was admitted to the same division of the New York Hospital on September 12, 1922, and discharged on September 25, 1922. The history of appendicitis was of three days' duration with very persistent vomiting. On admission he was acutely ill with temperature 104.4, pulse 124, leucocytes 9600, with 85 per cent. polymorphonuclears. The abdomen was much distended, rigid, and tender over all.

An immediate appendectomy was performed and a gangrenous appendix without any walling off was found, together with a large amount of free purulent fluid. The operator, Doctor Dineen, decided that an immediate jejunostomy was indicated for relief of paralytic ileus, and this operation was performed at once; the bowel was red and distended. A small quantity of bile-stained fecaloid material was obtained on introducing the tube.

During the first post-operative day a large amount of discharge occurred (amount not measured), 1150 c.c. on the second day, 850 on the third and only 30 c.c. on the fourth. On the fourth day a good evacuation was accomplished after pituitrin and a colon irrigation. The tube was removed on the fifth day followed by no appreciable leakage. The patient was discharged on the thirteenth day after operation.

Two months later (November 19, 1922,) he was given a barium meal, but the X-rays did not reveal any abnormality, adhesions or deformity of the tract.

Either this case represents a rather remarkable benefit due to an early jejunostomy for paralytic ileus of general peritonitis, or one may feel that the boy would have recovered without this procedure.

ACUTE DIFFUSE PERITONITIS OF UNDETERMINED ETIOLOGY THREE YEARS AFTER ACUTE PANCREATITIS

DR. ALLEN O. WHIPPLE presented a woman, who was fifty-three years of age on admission, in January, 1919, to the Presbyterian Hospital, with the history that eighteen hours before admission she was suddenly awakened with a very severe, sharp pain in the left upper quadrant of the abdomen. This quickly spread through the abdomen, becoming generalized and centring in the region of the umbilicus. She vomited first nine hours before admission, and twice afterwards. Bowels had failed to move for fifteen hours before admission. She had noted tenderness in the abdomen from the onset of the attack, but had no respiratory, cardiac or renal symptoms.

Past History.—Nine years previously she had had a severe attack of pain in the right upper quadrant associated with jaundice. At that time she passed three facetted stones. One year later, that is eight years previously, she had a similar attack and passed three more stones. In the interval of eight years she had had no symptoms of acute pain or interval digestive disturbances. Has had two children; no miscarriages. Bowels have been constipated. Never had typhoid.

On admission temperature was 101.4, pulse 96, respirations 22. She was pale, somewhat anæmic, had a suggestion of icterus in the scleræ. Tongue was dry, coated. Throat negative, and chest was negative. Abdomen was distended, showed a wide costal angle. There was acute deep tenderness

over the entire right side and especially over the epigastrium and right upper quadrant; there was distinct rebound tenderness at the umbilicus. Rigidity was present in both quadrants on the right side, less on the left. Respiratory movements were splinted. Pelvic examination was negative. White blood-cells 12,300, polymorphonuclears 90 per cent., blood sugar was 1.4 grams per litre. Wassermann negative. Because of her previous history and the acute signs over the right side of the abdomen, ante-operative diagnosis of acute cholecystitis with diffuse peritonitis was made.

Under drop ether anæsthesia, a right rectus incision was made. There was a large amount of turbid bile-stained fluid in the right side of the abdomen, in the pelvis and left lower quadrant. Large amounts of it were present in the retroperitoneal tissues on the right side both as free fluid and as œdema. Retroperitoneal tissues on the right side were soggy with œdema, in places 6 to 8 cm. thick. Fat was bile-stained and in the right upper quadrant showed areas of fat necrosis. There was a general irritative peritonitis. The gall-bladder was not distended. It was only slightly thickened, and contained a thick, dark green bile. No stones were found on careful search. The gastro-hepatic omentum was so œdematous as to preclude definition of the common duct; duodenum and pylorus felt normal. The pancreas was enormously increased in size, having the feel and size of a clenched fist at the head. The process involved head, body and tail. The lesser sac was obliterated as a result of the increase in size of the pancreas and the œdema of the retro-peritoneal tissues. Diagnosis of acute pancreatitis was based on the lesion of the pancreas and areas of fat necrosis. A cholecystostomy was done with drainage of the lesser sac through the gastro-hepatic omentum with a rolled cigarette drain. Culture of the fluid showed a non-hæmolytic streptococcus.

The post-operative course was remarkably smooth. She made a rapid recovery. Followed up for five visits over a period of thirty-six months showing optimum anatomic, symptomatic and economic result—that is 4 4 4.

Forty months after the operation she had an attack of epigastric pain, severe in character, radiating to both shoulders. This lasted for two hours, and she was jaundiced for one day. Two months later, that is forty-two months after the first operation, she came to the accident ward with the history that almost every week since attack two months ago she has had epigastric pain with considerable bloating and belching and has been constipated. The present attack started twenty-four hours ago and began with pain in left lumbar region, which passed around to epigastrium and radiated to both shoulders. Vomited three or four times. Bowels moved yesterday. No jaundice.

Physical Examination.—Rather obese; color good; no jaundice. Temperature 99.8, pulse 98, respirations 22; 15,000 polymorphonuclears (94 per cent.). Blood-pressure 118/64. Her abdomen was distended, tender in all quadrants, but most marked in left upper quadrant and epigastrium and left costo-vertebral angle. Rebound tenderness present. Rigidity present in all quadrants. No masses made out. No fluid was elicited. No loss of liver dulness. An examiner made a diagnosis of acute pancreatitis. Blood urea 0.89 grams per litre. CO_2 52.2 vol. per cent., chloroform anæsthesia.

Upon opening the abdomen the pancreas was felt normal in size and consistency. No fat necrosis seen. Gall-bladder felt normal in size, was not inflamed, although there were old adhesions about it from previous drainage. Duodenum and stomach normal. No perforation found. Appendix small, atrophic. Pelvic organs negative. No focus could be found to explain presence of sticky, purulent exudate in lower abdomen and the acutely congested gut throughout. Pus was odorless, thin, sero-purulent, yellowish.

Incision: right para rectus. Penrose tubes down to serosa. Culture of pus, no growth. Smears, Gram-positive cocci.

Complications, none. Drains all out by seventh day. Home twenty-third day. Forty-five and two months—4 4 4, 123 pounds. Fifty-one and eight months, 4 4 4, 133 pounds. No digestive disturbances. Firm scars. Fifty-three and ten months, 130 pounds. No indigestion. General condition excellent. No attacks of pain. Px. General appearance good. Reaffirms the passage of gall-stones.

Dr. Richard Lewisohn said it was possible these attacks might have been caused by stones higher up in the hepatic ducts, which when coming down caused jaundice and other severe symptoms with secondary infection. He showed before this Society a few years ago a man operated on eight years previously for intra-hepatic stones which had come to the surface and which he cut out from the surface of the liver. This patient was afterward readmitted to Beth Israel Hospital as an emergency case and operated on by Doctor Isaacs who found a large abscess in the upper abdomen with localized peritonitis between the liver, the pancreas and the stomach. As no cause could be determined for the abscess, simple drainage was instituted. The man made an uneventful recovery. Doctor Whipple's case might be of similar nature.

Dr. Joseph A. Blake asked Doctor Whipple if he was sure this was not a pneumococcic peritonitis, and if he had examined the Fallopian tubes.

Doctor Whipple replied to Doctor Blake's question that the pelvis was carefully palpated and the tubes felt normal. The uterus was atrophic and the tubes felt thin and normal. Smears from the pus showed a chain type of coccus, and though there were signs of a questionable pulmonary condition the patient did not develop a pneumonia and the physical signs cleared up after operation. The tubes had been thought of as the source of the infection, but the smears looked like streptococcus rather than pneumococcus.

In reply to Doctor Lewisohn, he feared he had given a wrong impression; the pus was not in the upper but in the lower abdomen and suggested the condition Doctor Blake had mentioned. At the first and second operations the patient had diffuse peritonitis. The first was of the irritative type, and it seemed to him the less one did in those acute irritative peritonides associated with pancreatitis, the better; simply letting out the fluid was better than to attempt anything further. If the source of the infection were acute cholecystitis, then the focus should be drained or removed.

THE TREATMENT OF SUPPURATIVE PERITONITIS

Dr. Joseph A. Blake read a paper with the above title, for which see the Annals of Surgery for May, 1924.

Dr. Walton Martin said that when he had the pleasure of working with Doctor Blake he always felt that he (Doctor Blake) was attempting to get a very definite idea of the pathology first and then work out a rational treatment. He then was using the two-way irrigator, as he had said. At that time there was a very large emergency service at Roosevelt Hospital and

there were many cases of perforation in the gastro-intestinal tract, pathological and traumatic. The double current irrigator introduced through a small abdominal wound was certainly an effective method of removing mechanically foreign bodies such as food particles and fæces. Doctor Martin said that he remembered a fragment of lettuce leaf washed out of the pelvis after a gastric perforation. It was his impression that patients came to operation later twenty years ago than they do now and as there is the well-known relation between the time interval between perforation and operation and the results, it is difficult, it seemed to him, to make comparison of methods of treatment. He thought, however, that to-day when there is much less irrigation used there are possibly fewer residual abscesses, but the mortality is still largely determined by the removal of the focus of infection before the peritoneal contamination has lasted for more than a few hours. Different methods of treatment of the peritoneum seem to give fairly satisfactory results in perforations operated on and closed within twelve hours and none seem to give satisfactory results after twenty-four or forty-eight hours. The speedy recognition and removal of the focus, he thought, is to-day generally recognized as the essential point. Whether or not when the irrigator was introduced into all quadrants of the abdomen in the early cases and cloudy exudate removed, we were not actually removing a protective fluid furnished by the peritoneal cells is a question.

Doctor Martin remembered when Doctor Blake read his original paper advising against the attempt to drain the general peritoneal cavity, he was annoyed by his teaching being misinterpreted and being called in to see patients in whom well-marked circumscribed peritoneal abscesses had been opened, washed and then immediately closed with most unsatisfactory results. Circumscribed collections of pus should be drained. It is impossible to drain the general peritoneal cavity and Doctor Martin thought the timely work that Doctor Blake and a number of other surgeons did twenty years ago, in bringing out the fact that the effort to drain not only was useless, but distinctly harmful, was most important.

Dr. Allen O. Whipple said the instruction as now given in the third and fourth-year surgical courses at the College of Physicians and Surgeons, as regards the treatment of peritonitis, shows a close adherence to the principles that Doctor Blake proposed in his former contributions. The students are given the following dictum: "Early diagnosis of peritonitis with an accurate diagnosis of the initial focus or portal of infection, early operation by a competent surgeon, with nothing more than a rapid removal of the focus or closure of the portal of infection with or without proper drainage, and finally the correct post-operative care, are the cardinal factors in the therapy of acute peritonitis." "As regards drainage, no hard or fast rule can be given, but it may be stated that if the focus of infection is removed, drainage should not be used unless any one part of the peritoneum appears more definitely damaged than another part. Stated in other terms, drain to and when (*a*) a part of the peritoneum shows necrosis or probable necrosis, as

evidenced by fibrino-purulent adhesions; (*b*) the focus of infection has not been removed, or closure of the perforation has been unsatisfactory; (*c*) there is bleeding or oozing at the site of removal of the focus."

Dr. Franz Torek said that on the occasion of Doctor Blake reading a paper on this subject about twenty years ago, before the Academy of Medicine, when the reader advocated the use of the double current irrigating tube, he took part in the discussion and described his method of managing the cases of widely diffused suppurative peritonitis of appendiceal origin, usually called general peritonitis, by a large incision, thorough but gentle lavage, and closure without drainage. His method remained the same to-day. At that time he had given his experience with diffuse suppurative peritonitis, meaning very far-spreading peritonitis that involved the left half as well as the right. He had then had eight cases without a death. The method consisted of making an opening in the median line extending from the pubes to some distance above the umbilicus, removal of the focus of infection, and cleaning the peritoneal cavity by lavage with saline solution. Doctor Blake had issued a warning against being excessively rough and thorough, but the speaker believed one should not mix those two conceptions; one may be exceedingly thorough without being in the least rough. The peritoneal cavity should be cleaned out with the greatest gentleness possible and the fluid rocked about with the gloved hand. Doctor Torek had published two sets of cases, totaling 36 in number, of which 6 died, a mortality of $16^2/_3$ per cent. The second series was published in 1908, and since then he had not gathered his statistics but was sure they were no worse. Among the things he brought out at that discussion in 1904 was the statement that he closed the peritoneal cavity completely, without drainage. At that time such a procedure was considered rank heresy, when many surgeons were in the habit of draining even after clean abdominal operations, such as hysterectomy, gastro-enterostomy, and the like. But to close after an operation for a suppurative process seemed nonsensical. The Fowler position was then in vogue and Doctor Blake also had expressed himself in favor of the Fowler position with drainage in the pelvis. The speaker had then pointed out that drainage into the pelvis by gravity was a delusion. A large amount of pus might be caused to flow down by gravity, if not impeded by adhesions, but a sprinkling of freshly formed pus, such as might happen after a cleaning of the peritoneum, will not be influenced by gravity to run into the pelvis, and it was for that reason that the speaker had said it was impossible to drain the peritoneum through the pelvis. Doctor Torek said he wanted to impress the fact that a wide open wound did not mean roughness. If there were a large, wide opening, the intestines could be handled more gently than by introducing a tube through a small opening. Extreme gentleness was indicated. Wiping the peritoneum was bad, as it was apt to cause traumatism. Pus could be removed from secreted spots by lavage aided by a gentle motion of the hand. Injury to the peritoneum should be avoided, so that it may not lose its power to combat infection.

DR. ROBERT T. MORRIS said that the points made in the discussion might be classified clearly in two separate categories.

Extensive drainage of the abdomen and free handling of bowel, together with the employment of large openings, belong to the third era of surgery. In that era, the dominant idea was that the surgeon himself should remove bacteria and their by-products regardless of any injury that he might cause the patient when doing this work conscientiously.

The paper of Doctor Blake dealt with features of the fourth era or physiologic era in which dependence is placed upon the patient's own protective resources. Ochsner's starvation method belonged in that group, but in addition to the Ochsner plan Doctor Morris agreed with Doctor Blake that a five-minute operation with superficial drainage constituted an improvement in Ochsner's technic.

DOCTOR MORRIS said that he did not believe that large incisions or extensive methods of flushing or cleansing the peritoneal cavity could be conducted gently. The nearer that a surgeon came to leaving a patient to his own resources, the more nearly he was in accord with the principles of the fourth era of surgery which Doctor Blake had included in the paper of the evening.

DR. JOSEPH WIENER said there seemed to be a general agreement that traumatism in peritonitis was to be avoided. Time also was an important element if a general anæsthetic were used, but if the anæsthetic was eliminated the length of time occupied by the ordinary operation in these cases was of no importance to the patient. With local anæsthesia most of the disagreeable after-effects had been eliminated. When the speaker started using local anæsthesia he planned to use it in cases of peritonitis, and he had now a long list of peritonitis cases done under local anæsthesia. If eliminated the trauma to the internal organs, the kidneys, and lungs, which ether produced, and which local anæsthesia did not produce. It was astonishing in cases of peritonitis, so severe that the gentlest examination caused severe pain, an operation such as taking stones from the hepatic duct or removing a gangrened appendix could be done absolutely painlessly. Many lives had been saved by the abolition of general anæsthesia in operations for peritonitis.

DR. HUGH AUCHINCLOSS said that during the years 1907–1908, as house surgeon, he had the opportunity of watching the cases Doctor Blake and Doctor Martin operated on for appendicitis at Roosevelt Hospital. They included most of the sorts and degrees of acute peritonitis with appendicitis. There was but one death in five months. This was a woman who had been under observation for a supposed salpingitis elsewhere for four days. She had a large, distended appendix full of pus. This was removed, the abdominal condition subsided, her bowels moved, but ten days later she died of sepsis. An indication of the fact that there was no scarcity of cases in this series will be seen by the number of these patients; seventeen cases were admitted to Doctor Blake's division to one case on the opposite division during the first part of the five months. They were all dealt with according to the principles outlined by Doctor Blake in his paper a few years previously.

He retained a most vivid impression of a young man brought in about six hours after the onset of acute symptoms. His abdomen was opened by a McBurney incision and real, creamy white pus was removed in considerable amount from the pelvis. To his astonishment the wound was closed tightly by Doctor Blake and uninterrupted convalescence followed with no subsequent infection. That was sixteen years ago and illustrates clearly the faith Doctor Blake has had in the principle that if peritoneal necrosis had not occurred, as in this case as well as in many an early case of perforated gastric ulcer, there had not been sufficient time for such a thing to take place, the indication lay in removal of the cause and avoidance of drainage necrosis.

Dr. F. T. Van Beuren wondered what rule Doctor Blake used in deciding whether to do an ileostomy or a jejunostomy. He himself had seen striking cases where unexpected improvement had occurred after enterostomy and he had wondered whether it was due to the jejunostomy or not. Those who had had the advantage of working with Doctor Blake at different times had many things to thank him for, but the thing that had helped the speaker most was the rule of Doctor Blake's, that when he operated on any case he first had a definite idea of the pathology—made a definite plan for procedure beforehand—and so saved time.

Dr. Eugene H. Pool considered that in the discussion of the paper a disproportionate emphasis had been put upon the subject of irrigation of the abdominal cavity. One speaker had said that he regularly flushes out the peritoneal cavity in spreading peritonitis. Doctor Pool's own feeling is that there are very rarely indications to irrigate the peritoneal cavity and he was sure that it could not be "washed out." Even with obvious contamination it is best not to attempt the process of irrigation. In regard to the question of ileostomy, on his service at the New York Hospital, the speaker said that a considerable number had been done for ileus following or associated with peritonitis, but only in cases that seemed hopeless. An independent incision was made and a catheter was introduced into a loop as high as possible. In a number of cases the result was phenomenal, the improvement was so rapid.

Doctor Blake, in closing the discussion, answered Doctor Van Beuren's query as to the rule in doing ileostomy, that if ileus has been present before the peritonitis, it was justifiable to believe it would continue and increase. He confined ileostomy to those cases that he thought would not get well without it. It was difficult to lay down definite rules for these cases. One of the last which he remembered was a typhoid perforation with extensive contamination of twelve hours' duration. He closed the perforation and did an ileostomy in the centre of the distended loop. It is necessary in such cases to get the distended loop emptied, and if one got the impression that the loop would remain distended it was better to do an ileostomy. Doctor Blake believed ileostomy was indicated in cases of paralytic ileus following peritonitis and prevented many from becoming mechanical.

The speaker considered that Doctor Morris had hit the nail on the head long ago regarding the treatment of peritonitis, and believed surgeons owed

much to him, much of his own work in making small incisions and eliminating drainage having been due to Doctor Morris' influence. In desperate cases the best thing to do was to remove the cause of infection and do little more.

In regard to Doctor Martin's point about the exudate being protective, he believed that this fluid contained toxins as well as antitoxins. But this purulent exudate was not an index of the extent of the infection. The peritoneum had power to absorb it so the mere presence of pus was not an indication for cleansing the peritoneum, though one should clean out necrotic material. Proper cleansing of the peritoneum was a limited operation, and Doctor Blake did not believe one should leave in foreign bodies. Doctor Pool had done excellent work overseas, and it was certain that he had not left any fragments of shell or clothing in the knee-joints he had treated and it was just as reasonable not to leave foreign material in the peritoneum. Washing out the peritoneum was a very simple matter; it was not necessary to explore the abdomen but merely to pour the cleansing material in. As to Doctor Wiener's remarks regarding local anæsthesia, the speaker was in accord with them; these patients had a much better chance of recovery with local anæsthesia. General anæsthesia does produce additional traumatism to the lungs and kidneys. But there are many cases in which the advantages of general anæsthesia outweigh its additional risk.

BOOK REVIEWS

OPERATIVE SURGERY. By WARREN STONE BICKHAM, M.D. Six volumes, octavo, 6000 pages, 6378 illustrations. Saunders Co., Philadelphia-London, 1924.

The first three volumes of the six planned by the author have been offered for review. The work presents an elaboration of the very excellent previous one-volume editions, covering the same subject in a much more compact form. More interest is afforded the reader when it is realized that we have presented the personal and individual work of a single author, differing thus from practically all those systems of surgery which are the combined work of many collaborators.

Its scope, as is definitely stated, is a consideration of the operative technic involved in the operations of general and special surgery. The subject is divided into three major parts: namely Part I, General Procedures Employed in Surgical Operations; Part II, General Operative Surgery, and, Part III, Special Operative Surgery.

One is primarily impressed by the general excellence of the binding—the usable and convenient size of the volumes—the well calendered paper which in turn has allowed of excellent reproduction of the author's profuse illustrations, over six thousand in number, and a very legible text—rendering the terse facile descriptions of technic more easily appreciable. Considerations of etiology, symptomatology, pathology, complications, diagnosis and prognosis are properly omitted. For these one is referred to the works on general surgery. Part I, exhaustively considers the preparation for operations—the induction of anæsthesia by various agents and analgesia. The conduction of operations and general operative technics, and not the least important, the after-care of operated patients, all of these subjects are taken up in minute detail; all phases are well and instructively illustrated, and readably presented, constituting three hundred fifty-one (351) pages of text.

Part II, on General Operative Surgery, incorporates many of the lessons learned during the past few years at so great a cost. Thus, the subject of skin-grafting and the general principles of reformative, reconstructive or plastic surgery and dermoplasty is particularly instructive and well presented. These chapters are followed by three which deserve especial mention, as they represent phases of orthopædic activity to which too little attention has been given in contemporary works, but which, owing chiefly to the tens of thousands of maimed cases we have to care for at the present time, should be given much greater prominence. Much information, therefore, may be gleaned from the author's presentation of the practical use of hydrocarbon protheses, while his authoritative and original interest in cineplastic amputations and cinematic protheses is well known and deservedly recognized. An interesting chapter is devoted to artificial limbs, their various types, indications for use

and the general features of their adjustment, a matter which should be much more earnestly considered by the higher class surgeon and in which he should collaborate more closely with the mechanic, instead of delegating the matter entirely to the latter. All of the above work is freely illustrated and the text thus amplified where it is most needed.

The second volume contains the descriptive technic of operative surgery upon the blood and lymph vessels, nerves, bones, muscles, cartilages, fascia, etc., and includes the special operative surgery upon the skull, brain, spine and spinal cord.

The author has designated the various operations by considering first, the surgical description of the special operative technic; second, by the anatomical designation of the structures involved, and last, the name of the deviser of the operation. In dealing with each group of tissues or class of operation or individual organ, we note the definite arrangement of first, the outline of the surgical anatomy of the region or organ; second, the surface form and landmarks, and third, the general surgical considerations involved, all of which are prefactory to the succeeding specific operations, each of which is introduced by its descriptive title, followed by the necessary preparation of the patient and operation site, the position of the patient, etc., landmarks, incision, detail of steps in operation and comments.

The third volume deals with operative procedure on a multiplicity of organs, as the eyes, ears, nose, neck, tongue, thyroid, breast, chest, etc.

The general scheme as indicated above continues to be systematically carried out. The plastic nature of much of the operative work involved, naturally necessitates elaborate illustration, which has been ably accomplished. To be noted particularly are the details of the various methods of rhinoplasty, cheiloplasty and stomatoplasty. The details of tubular flaps are not, however, noted; one wishes that this method might have been shown. The procedures of sliding or swinging are excellently portrayed, however. The omission of œsophagectomy for cancer of the thoracic portion of the œsophagus, which has been successfully accomplished, is also noted; its description would have enhanced the value of the chapter devoted to this subject.

The three volumes above reviewed are therefore worthy of much commendation. The amount of knowledge they impart, the methodical and concise manner of presentation and the profuseness and excellence of illustration, leave little to be desired. We hope, and feel confident that the remainder of the work will prove equally satisfactory.

JAMES T. PILCHER.

HERNIA. By LEIGH F. WATSON, M.D., Associate in Surgery, Rush Medical College, Chicago, Ill. Large 8vo, 660 pages, cloth. St. Louis, C. V. Mosby Company, 1924.

THE preparation of this book has extended over a period of four years and the author has endeavored to present, within a reasonable space, the most important features of the anatomy, symptoms, diagnosis, prognosis and

the best modern operative technic of hernia. The entire subject has been exhaustively treated. It will seldom be necessary to look further for any information, but for those who desire to make deeper investigations, there has been added, at the close of each chapter, an extensive bibliography. The recent renewal of interest in the subject of hernia, especially from the standpoint of permanent cure, makes the publication of this book a timely one. We wish that every physician could read the section on the Dangers of Taxis in Strangulated Hernia. There are thirteen mentioned and they seem very real to the reviewer who, recently, during an operation for strangulated hernia, saw a loop of discolored, ecchymotic intestines which had been damaged by an attempt at reduction of one hour's duration.

Twenty-seven pages are devoted to the Anatomy of Inguinal Hernia "to render unnecessary a search through the more exhaustive treatises devoted exclusively to anatomy." The various drugs used to produce local anæsthesia are described and there are many illustrations showing the methods of administration—step by step.

It would be difficult to find any method of operative treatment of inguinal hernia, or any little modification in technic advocated by anyone that is not mentioned and clearly described or depicted. As an illustration, in discussing the disposition of the sac the preferences of thirty-six different men are mentioned. The Modified Bassini, Halsted, Ferguson, and Andrews operations are beautifully shown and the Author's, LaRoque's, Stetten's and Scott's modifications are also sketched, while seven others are described. Six methods for the treatment of direct hernia are illustrated. This section on Inguinal Hernial is followed by a bibliography of seven pages.

The illustrations of the operation for Umbilical Hernia in adults are unusually numerous, large and clear. The more rare hernias, such as Lumbar, Obturator, Perineal, Sciatic and Diaphragmatic receive suitable space. The section on Internal Hernia is very interesting and well worthy of perusal by any surgeon. An especial word of commendation should be given to the artist, W. C. Shepard, for the splendid drawings which show the most painstaking care.

The book ends with a chapter on the Medico-legal Aspects of Hernia.

This volume may be used either as a text-book or for reference purposes. The author may well be proud of this production which shows so plainly the many long hours of study and the zeal of its creator.

HENRY F. GRAHAM.

SELECTED ESSAYS ON ORTHOPÆDIC SURGERY. By NEWTON MELMAN SHAFFER, M.D., with Forewords by Doctors Lovett and Fisher, and Comments by Doctors Cotton and Nutt and by Messrs. Blagden and Harden. G. P. Putnam's Sons, New York and London, 1923.

When a recognized leader in any human endeavor writes on the subject of which he is master, the reading public takes notice; when that leader is a specialist in one of the fields of surgery and gives forth the fruits of years

of thought and practice in that field, the profession realizes that a work is available which is a monument to that man's life. This is such a book.

Most of the chapters are reprints of lectures or essays on subjects given at various times during the long and useful life of the author. All of the essays are dated; they cover twenty-seven years from 1877 to 1904. The occasional footnotes, made by the author in 1923, increase the scope of the essays to forty-six years. The subjects treated in no sense comprise the field of Orthopædic Surgery as we understand it to-day. But forty to fifty years ago, there was almost bitter controversy over the subject of tuberculosis of joints; so a major part of the text treats in a masterly way such questions as the causes of deformity and how to combat them, should "cold abscesses" be opened and drained, the relative value of traction and non-weight-bearing as compared with fixation and weight-bearing, in hip-joint disease. Doctor Shaffer thought strongly on these questions, his conclusions were based on intensive study of his many cases in his large public and private practice, and they stand to-day as the best thought on these subjects. Other conditions discussed in this work are lateral curvature of the spine, club-foot, flat-foot, knock-knees and bow-legs, deranged semilunar cartilages and fracture of the neck of the femur. As he always gave preference to the use of apparatus over operative procedures, as he had a master's leadership in its use, so many of these essays are careful descriptions of the indications for and the detail in the use of apparatus.

The forewords are written with appreciation of the author and the comments record historical data in connection with the growth of two of the leading Orthopædic Hospitals of the country. The book is thoroughly illustrated and is attractively printed.

It is valuable to the medical student to-day as a record of one who has borne his share in the development of Orthopædic Surgery, whose contribution has been preëminent in the description and care of tuberculosis of joints, and in the use of apparatus. His mastery of the principles of mechanical treatment is worth careful study to-day. To one hoping to find a record of the marked advance in operative Orthopædic Surgery, which the past twenty-five years have developed, there will be disappointment. The author did not think in terms of operating and he has not followed this more recent development of his specialty.

WALTER TRUSLOW.

CORRESPONDENCE

GASTRO-JEJUNO-COLIC FISTULA

EDITOR ANNALS OF SURGERY:

Sir:

In the ANNALS OF SURGERY, April, 1923, Pratt reported a case of gastro-colic fistula due to carcinoma, and considered 127 other cases gathered from the literature, and concluded from the material studied that in order of frequency the cause of this condition is to be found in: "First, cancer; second, ulcer; third, following gastro-enterostomy; fourth, tuberculosis, and lastly, congenital anomalies." In the case here reported, marginal ulcer following gastro-enterostomy was the apparent etiological factor.

CASE REPORT. *History.*—The patient, an unmarried man, aged thirty-one, a Russian Jew, was referred to this hospital in January, 1923, by a physician in Harbin, Manchuria. On admission he gave a history of an acute gastro-intestinal attack after a heavy meal in March, 1922. This attack was followed by a persistent diarrhœa with six to eight light brown liquid stools per day, and by frequent foul eructations. He was examined in Harbin in October, 1922, and at that time the stomach examination revealed 30 c.c. of foul yellowish-gray material in the fasting stomach with no free hydrochloric acid, but with much lactic acid, many Oppler-Boas bacilli, starch granules and muscle fibres. After a test meal, the findings were, HCl, 26; total acid, 43. Repeated lavage afforded some relief.

Since 1908, the patient had suffered from epigastric pain coming on about three hours after eating. The appendix was removed in 1915 through a McBurney incision. The symptoms were not relieved, and a gastro-enterostomy was done in a large hospital in New York in 1918, when a diagnosis of duodenal ulcer was made. A severe hemorrhage occurred two weeks after the operation, and the convalescence was prolonged and stormy. Recovery was not complete, nevertheless the patient entered the army and was able to carry out the duties of camp life. He was never free from his old pain, however, and was at one time treated medically in an army hospital for six weeks without relief. Following the operation in 1918, the epigastric pain after meals recurred periodically, often being localized upon the left side, radiating downward to the left.

The patient came to China, in May, 1919. In December of that year, his epigastric pain being so severe he had a stomach examination made in Harbin, the report being "very much acid and HCl." There has been little change in weight during the past five years.

Examination showed the patient to be a moderately well-nourished man; weight 56 kilos. The general physical examination was negative. There was a small post-operative hernia in the right rectus incision. The abdomen

was slightly distended and tympanic, and there was definite tenderness in the upper left quadrant above and to the left of the umbilicus. The fasting stomach contained a small amount of a grayish foul fluid showing no free HCl, but with a total acidity of 64. Following the test meal, free HCl was present for 45 minutes with readings of 62, 42 and 56 with corresponding total acidity readings of 82, 60 and 72. Free HCl disappeared in one hour. During the next hour the total acidity varied from 14 to 54. The specimens were taken every fifteen minutes through the Rehfuss tube.

Fluoroscopic examination showed no gastric residue after a six-hour meal. The gastro-enterostomy opening was patent, but a part of the opaque meal passed down the left side apparently into the sigmoid and rectum. When the barium reached this point the patient wished to defecate and the stool passed seemed to contain fresh barium. A barium enema was given after the gastro-intestinal tract had been cleaned out and was seen to pass into the transverse colon and to fill the stomach at once. This observation was immediately confirmed by the recovery from the stomach of the barium enema through a stomach tube, and a chemical examination revealed unchanged barium. The routine laboratory findings were all within normal limits. A diagnosis of gastro-jejuno-colic fistula was made.

Operation.—January 26, 1923. Anæsthetic, ether. Iodine skin preparation. A high left rectus incision was made and the upper right quadrant was found filled with dense adhesions. These were dissected free until the pylorus was seen. The duodenum was so buried in adhesions that it was not thought advisable to attempt its isolation, and it was not possible to determine whether or not a duodenal ulcer was present at the time of operation. The transverse colon was closely bound to the greater curvature of the stomach and an opening from the stomach into the colon could be easily felt. The jejunum was attached to the posterior wall of the stomach 15 cm. distal to Treitz's ligament. The colon was attached very close to the site of the anastomosis between the jejunum and the stomach. The gastro-enterostomy opening was patent.

The transverse colon was freed from its attachment to the stomach and its lumen was opened as it was dissected away. It was found to communicate with the stomach and with both loops of the jejunum. The edges of the opening into the colon were indurated, but did not give the impression of malignancy. The opening into the colon was easily closed. The gastro-enterostomy was then taken down. Careful search was made for a marginal ulcer and for a malignant growth. Neither were found. The edges of the opening into the stomach and jejunum were excised and with a few adjacent lymph-glands the tissue saved for pathological examination. A new gastro-jejunostomy was made at the same site, the new opening being considerably larger than the old.

Post-operative Notes.—The convalescence was uneventful save for a superficial wound infection. Pathological examination of the tissue excised from the site of the old gastro-enterostomy showed chronic inflammation, the

lymph-glands were slightly hyperplastic, and there was no evidence whatever of malignancy.

The patient was seen two months after discharge. At that time he was free from symptoms and had gained 6 kilos in weight. He returned to America at the end of March, 1923. A letter from him May 16, 1923, stated that the epigastric discomfort had recurred, and a further report June, 1923, stated that he had consulted a well-known surgeon in New York, who proposed another operation for marginal ulcer.

Discussion.—The case here presented is one of duodenal ulcer with long-continued hyperacidity and ulcer pain. An ineffective appendectomy was done through a grid iron incision which did not admit of thorough exploration and discovery of the important lesion, and a subsequent gastro-enterostomy became necessary. Following the gastro-enterostomy, symptoms which may reasonably be ascribed to a marginal ulcer set in and continued with remission and exacerbations for four years. When these symptoms were most acute in the fall of 1919, an examination of stomach contents showed high HCl. The onset of the diarrhœa was very sudden, and a subsequent stomach examination showed high organic acid with no free HCl. The examinations made in this hospital revealed high HCl lasting less than one hour after the test meal.

It seems reasonable to suppose that a marginal ulcer set in after the gastro-enterostomy and continued until the gastro-jejuno-colic fistula was formed. This new opening allowed dilution of the HCl with healing of the ulcer, which, however, seems to have recurred after the closure of the colic fistula when conditions again became favorable for the action of a corrosive acid secretion upon the jejunal mucosa. At the operation done here, the stomach and jejunum should not have been reunited. A plastic operation should have been done on the pylorus with excision of the ulcer base in the duodenum and the gastro-intestinal tract should have been reëstablished by a gastro-duodenostomy. The striking variation in the hydrochloric and organic acid obtained from the stomach during the existence of the opening into the colon may be explained by the rapid loss of stomach contents into the large bowel and by dilution by regurgitation of material from the colon. It is interesting that the marginal ulcer healed while the colic fistula was open, and promptly recurred upon its closure and reëstablishment of the gastrojejunostomy.

ADRIAN S. TAYLOR, M.D.,
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GANGRENE OF THE BREAST COMPLICATING DIABETES

EDITOR ANNALS OF SURGERY:

Sir:

Many investigators believe that there is a special tendency to vascular hypertension and arteriosclerosis in diabetic patients. Dry gangrene of the lower extremities is frequent when there are marked degenerative changes in the peripheral vascular system. In elderly patients the arteriosclerosis is fre-

quently so marked that the vessels may readily be shown by X-ray. The circulatory disturbances are not necessarily in the same proportion to the degree of glycosuria. Gangrene and infection are recognized as grave complications for the diabetic. Since the complications of diabetes have been reduced perceptibly with the advent of insulin, blood chemistry and rational diet, the occurrence of such an unusual complication of diabetes as gangrene of the breast, seems worthy of reporting.

W. U. Disp., B2456, Jewish, female, forty-eight years of age, was admitted to the Jewish Hospital from the Washington University Dispensary. Three weeks before admission to the hospital she had noticed a small bleb in the lower medial quadrant of the left breast. The bleb increased in size and ruptured, discharging a serous fluid. She was seen by a surgeon, who applied an ointment. The bleb was replaced by a rapidly increasing area of necrosis. A very foul odor came from the breast. There was no incapacity. She did not give a history suggestive of diabetes, except for a loss of weight.

F.G. 1.—Showing gangrenous area of the breast.

Physical examination showed an obese female who appeared ill. Head negative. There were harsh breath sounds and fine râles over the left apex. A soft systolic murmur was audible over the apex of the heart. Abdomen and extremities negative, except for palpable dorsalis pedis arteries. Examination of the left breast revealed it to be swollen with an infected gangrenous area over the left lower half of the breast about 6 cm. in diameter (Fig. 1). The necrotic area was surrounded by redness and induration. It was very tender to palpation. Temperature 103 degrees. Pulse 100. Respiration 24. Leucocyte count 22,000. Urine: cloudy, specific gravity 1.022, acid in reaction, trace of albumen and Fehling's solution gave a markedly positive reaction for sugar. Acetone present. Blood sugar 0.213 per cent.

The treatment of the diabetes was carried out by Doctors Strauss and

Taussig. Test diets were given along with 5 c.c. of insulin t.i.d. Acetone disappeared from the urine in three days and she became sugar free in five days. A maintenance diet was continued with 15 units of insulin daily.

The surgical care of the breast consisted in applying hot boric packs until the slough separated and granulations appeared. The granulating area became covered with epithelium and the patient was discharged from the hospital 36 days after entering.

Approximately five weeks later after a dietary indiscretion, another bleb appeared on the left breast. Her urine contained considerable sugar and acetone. She was returned to the hospital for further treatment. She again became sugar free and the breast has nearly healed.

The effective treatment of diabetes by diet and more recently by the addition of insulin, is recognized as the first means of treating all complications. The clinical progress of so-called diabetic gangrene is greatly dependent on the ability of the patient to maintain a proper diet and withstand infections. In general, minimum operative intervention is indicated in diabetic patients, yet it must be radical enough in gangrene and infection to rid the patient of a focus likely to promote a glycosuria.

JACOB G. PROBSTEIN, M.D.,
St. Louis, Mo.

PROLONGED WEARING OF A PLASTER BANDAGE WITHOUT REMOVAL

EDITOR ANNALS OF SURGERY:

Sir:

July 16, 1918, a man, aged forty-seven, by occupation a farmer, presented himself at my office with a swollen, tender, right ankle which he stated was of six weeks' duration and due to an injury he had received when a large wooden gate had closed against him as he was passing through, and caught him above the heel while his foot was elevated on the toes in the act of making the step. X-ray showed no fractures, but a softening of the astragalus, middle and internal cuneiform bones. The foot was placed in a plaster bandage from the toes to the knee. An inexperienced bookkeeper in the office, together with my entrance into the Army a few days later, caused me to lose track of the patient altogether. This gentleman, not thinking it necessary to write me, wore the bandage until December 6, 1922, when he again presented himself to the office for examination, still wearing the original bandage. Examination showed the foot to be sound. When the case was removed, aside from a dry layer of cuticle about one-eighth inch thick covering the parts that had been enclosed in the case, and a complete deterioration of all cotton and bandage used beneath the case, no harm had been done. The bandage had remained on four years and five months, which I believe has been the longest time such a case has ever been worn without removal.

A. DAVID WILLMOTH, M.D.,
Louisville, Ky.

PNEUMATIC INJECTORS IN LOCAL ANÆSTHESIA

EDITOR ANNALS OF SURGERY:

Sir:

Referring to an article by Dr. William R. Meeker in the January number of ANNALS OF SURGERY, entitled Instrumentarium for Local Anæsthesia, Doctor Meeker's frank condemnation of pneumatic injectors and his statement that "such do not simplify the employment of local anæsthetics," is decidedly at variance with my experience with a pneumatic injector designed by Dr. R. E. Farr that I have been using for nearly two years.

In my hands the abdominal wall may be much more easily and more completely anæsthetized with the Farr apparatus than by the use of any of the hand-operated syringes. Inside of the abdomen, the advantages of the Farr injector in delicately flooding various subperitoneal areas are outstanding and infinitely superior. As a general surgeon who applies the various degrees of local anæsthesia to conform to each particular procedure, it is my experience that there is no comparison between the two methods, the pneumatic injector being so much superior to the hand-operated syringe.

ARTHUR ROGERS GRANT, M.D.,
Utica, N. Y.

THE PNEUMATIC INJECTOR FOR LOCAL ANÆSTHESIA

EDITOR ANNALS OF SURGERY:

Sir:

In the January, 1924, number of the ANNALS OF SURGERY there appeared an article by Dr. William R. Meeker, of Rochester, Minnesota, entitled "Instrumentarium for Local Anæsthesia."

As the instrument I have devised is the only Pneumatic Injector for Local Anæsthesia which has ever been placed upon the market and used to any great extent, the portion of Doctor Meeker's article pertaining to this instrument quite obviously refers to the apparatus devised by me. Doctor Meeker's criticism of the underlying principles, upon which the use of an apparatus of this type is founded, contains, I believe, a number of statements which, if allowed to go undisputed, may act as a harmful influence upon this most excellent method of obtaining anæsthesia.

First: As to the statement "* * * the only method of controlling the flow of the solution being by means of a stopcock." This statement totally ignores the most important refinement of the Pneumatic Injector, that is, the valve or cut-off which fits perfectly in the grip of the surgeon's hand and which allows him to inject into deep cavities without the hand intervening between the operator's eye and the point of injection. It furthermore ignores the operator's control of the solution which he has at his command at all times.

Second: As to whether "Such an instrument must of necessity be complicated, cumbersome and difficult to sterilize," even a superficial examination will show that the only portion of the apparatus with which the surgeon has

to deal is the valve or cut-off and needle. During fifteen years, cultures have been taken from the novocain solution, coming from the various models of the apparatus and have invariably failed to show bacterial growth. The fact that the cylinders and tubing can be sterilized by autoclave or by boiling, an attribute which is not common to all syringes, should effectively controvert the statement that the instrument is not easily sterilized.

Third: He states, "They usually require considerable work to assemble, which means that in most cases the adrenalin cannot be added to the novocain solution just before injection." Inasmuch as the assembling of the apparatus is entirely in the hands of the nurse, this statement should not constitute a serious indictment. The statement that the adrenalin solution cannot be added to the novocain just before using is an error for the novocain and adrenalin are *always* blended before being introduced into the cylinder.

Fourth: Doctor Meeker makes the point that "The fact that the operator does not furnish the force for the injection and that the pressure in the cylinder is the same in dense as in loose tissues, leads to an unequal distribution of solution." This statement assumes that one should ignore the most vital point in relation to the induction of local anæsthesia and that is the visualization of the point of the needle resulting from one's knowledge of anatomy and one's experience in developing the "feel" of the needle point as it meets varying degrees of resistance. His statement also ignores the fact that after only limited use of the Pneumatic Injector the surgeon develops a most acute sense of touch in relation to the tissues encountered by the needle point, and that he is furthermore in absolute control of the situation as the amount of pressure behind the solution can be changed instantly to meet the indications.

As to the question of muscle-tire, the facts are that local anæsthesia has failed to replace general anæsthesia with the degree of rapidity which its superiority justifies largely because its use has constituted in the surgeon's mind, an extra amount of labor and time, necessitating the mastering of numerous technical details. Another factor has been the patient's objection to the use of the method because of pain which has been produced by the faulty induction of local anæsthesia. It was, in fact, these considerations which impelled the writer to develop the Pneumatic Injector. Our many years of experience have demonstrated that it may be used for injecting all of the nerves of the body except in blocking at their origin the main trunks of the trigeminus, the brachial plexus and the sacral nerves.

The Pneumatic Injector, like syringes, is a mechanical device and therefore subject to imperfections. Yet an extended experience with this instrument leads the writer to unhesitatingly state that it offers the surgeon the best opportunity to introduce local anæsthesia solutions quickly, smoothly, equitably, accurately and painlessly of any instrument yet devised for this purpose.

ROBERT E. FARR, M.D.,
Minneapolis, Minn.

THE USE OF THE CAUTERY IN THE TREATMENT OF ABSCESS OF THE LUNG

EDITOR ANNALS OF SURGERY:

Sir:

During the past few years, the literature has been replete with articles on abscess of the lung, pulmonary suppuration, etc. Lilienthal, Willy Meyer, Evarts Graham, Robinson and others have contributed greatly to our knowledge in this matter. Within the last year, Graham casting about for a method less deadly than lobectomy, hit upon the use of actual cautery to ablate the cavity in lung abscess. He reports three successful cases. The method commends itself by its simplicity, and so far, by its affectiveness. Lobectomy is attended by a fearful mortality, probably over 50 per cent., in the hands of good surgeons. A method which promises as good a chance for cure, with no mortality, must be considered a boon to patient and surgeon.

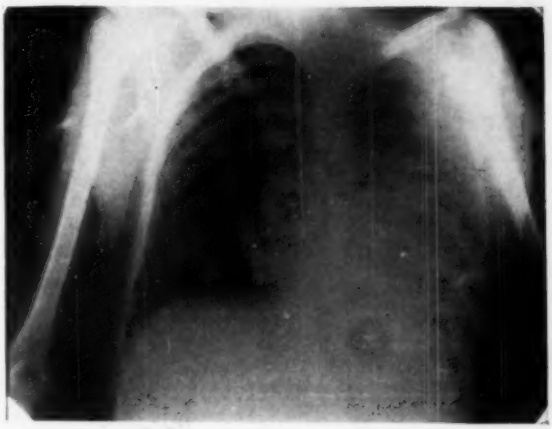

FIG. 1.—Before operation, November, 1922.

The case, which is here reported, is particularly convincing as to the efficacy of cauterization, in that the abscess had been previously opened and drained without effecting a cure. As soon as the drain was removed, all the distressing symptoms—cough, fever, and foul expectoration in large quantity—recurred. Eight months after the first operation, a perfect cure was obtained by the cautery.

FIG. 2.—After first operation, June, 1923.

The patient was an Italian girl, age six, who had evening temperature for about two months in 1920. This subsided completely under rest in bed for six weeks. Her tonsils, which were badly diseased, were thought to be the cause of the slight fever. In December, 1921, she was subjected to tonsillectomy. About twelve days later, she was taken with sharp pain low down in the left chest, followed by fever, with slight expectoration. The fever persisted, ranging from 99° F. to 100° F. in the evening, and there was noticeable odor to the breath. Repeated sputum examinations were negative for

tuberculosis. Later there was a gradual increasing output of foul, stinking sputum. At the end of two months this amounted to about three ounces daily. During this period, the leucocyte count averaged about 13,000, but was once as high as 24,000. In October, 1922, the left lung was aspirated with a large needle under ether. No pus was found.

In November, 1922, eleven months after onset, she was seen by Dr. H. P. Shugerman, who made a diagnosis of lung abscess, and insisted on operation. X-ray showed a vague shadow covering the entire lower left lobe. At this time the patient was referred to me for operation.

FIG. 3.—January 24, 1924. Shows left diaphragm and lower chest clear.

I did a wide thoracotomy, opening along the upper border of the eighth rib. The rib was not severed but wide retraction gave a splendid view. Between the diaphragm and the lower lobe was a grayish spot about 1×2 cm. A needle introduced here obtained 5 c.c. of thick yellow pus. The examining finger, plunged into the abscess cavity, found pus and necrotic lung tissue, with a dense, hard surrounding wall. The cavity connected mesially with a large bronchus. A rubber tube about one-half inch in diameter was inserted as a drain, a small section of rib being removed for this purpose, the wound closed by interrupted chromic gut embracing the two ribs which had been separated by the incision. Skin closed with interrupted sutures of silkworm gut and the drainage tube fastened to the skin by the same means.

Recovery was prompt. For a day or two there was blood-tinged, frothy expectoration; then none. At the same time there was a profuse foul-smelling, purulent discharge through and about the drainage tube, which after a few days, had to be removed and cleaned every day. The drainage was maintained for two months. Patient gained rapidly and was free from fever and cough, and there was no expectoration. As soon as the tube was removed and the wound closed, all the

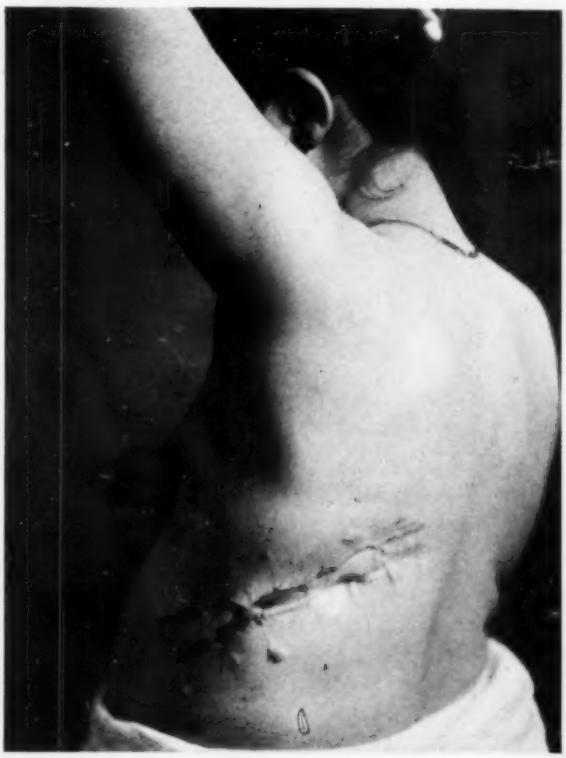

FIG. 4.—Patient recovered, wound healed.

old symptoms returned at once. After two weeks the drain was re-inserted under novocain. Prompt relief.

After two weeks of comfort, the drain slipped out and could not be replaced. Immediate recurrence of all distressing symptoms. She continued in this condition with fever, loss of flesh, strength and appetite. The amount of sputum gradually increased until the daily output was more than a pint. In the latter part of June, 1923, the patient had three alarming hemorrhages within ten days. She coughed up a pint of red fluid at one time, which contained enough blood for the entire mass to clot.

FIG. 5.—Patient recovered, wound healed.

It was decided to try to ablate the abscess cavity with the actual cautery. Accordingly, July 7, 1923, the patient was etherized and an incision was made along the upper border of the seventh rib. A segment of which one-half inch in length was resected near the angle. A similar segment was taken from the sixth rib. This gave an excellent exposure, and removing the segment prevented the after distress which is occasioned by the sawing, grating sensation in cases where the ribs are merely severed. The lower lobe was very small, almost totally collapsed and felt firm. It looked like a carneous lung. An exploring finger was forced through adhesions into the old abscess cavity. Blood clots, several bits of necrotic lung tissue the size of one's finger-end were removed. The cavity readily admitted three fingers and was slightly larger than a hen's egg. Air rushed in and out with the respiratory excursions. The ether having been removed to a safe distance, with the cautery tip in the cavity, and the fingers of the left hand on the surface of the lung in such manner that the two could be approximated, thereby gauging the pressure exerted by the cautery tip, the hard shell-like wall of the cavity was methodically burned away until everywhere the fingers felt soft lung tissue. During the application of the cautery, smoke issued from the nose and mouth. The ordinary flat electrode was used. After applying the cautery fifteen or twenty seconds, complete apnœa would result. Movements of artificial respiration would again induce breathing. This was repeated about five times. The manner of applying the cautery was by short interrupted strokes, much as one would spread a stiff ointment with a spatula. A stiff brush was most useful in cleansing the cautery tip. The cautery tip was plunged into the large connecting bronchus, after an unsuccessful attempt to close its lumen by suture. A large rubber tube was inserted deeply into the cavity, and rubber dam packed loosely about, in such manner that it could be removed alongside the drainage tube. Hemorrhage, which might conceivably happen after cauterization, did not occur. Convalescence was uneventful. For three days respiration was increased and the temperature rose to 102° F., then gradually fell to normal. There was some cough, but no expectoration.

Drainage from the wound was fairly profuse at first, but rapidly diminished, and in ten days was very slight. Three weeks after the operation, the tube which had been gradually shortened, was removed, and three days later the wound had healed. The patient, whose temperature had now been normal ten days, was allowed to go home. She gained rapidly in strength and flesh, and her appetite was enormous. She has had no fever, no cough, and no expectoration since leaving the hospital. The wound has remained perfectly healed, and is free from pain and tenderness, and there have been no hemorrhages. In seven months she has gained fifty pounds, the clubbing of the fingers, which was extreme, has almost entirely disappeared. In every way she is to-day a normal healthy child.

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